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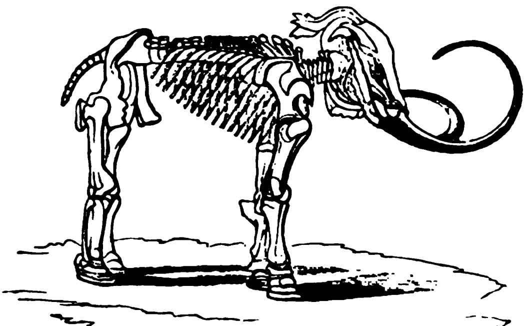
OF

GEOLOGY.

EDITED BY S. J. MACKIE, F.G.S., F.S.A.



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PREFACE.

Again the pleasant task recurs of thanking my friends for their encouragement and assistance; my only regret being, that the number of contributors to thank is less than heretofore. Those who have lightened by their contributions the labour which otherwise would have devolved on myself, have, during the past year, done me real service.

The papers and letters by my friends Mr. Du Noyer, the Rev. Hugh Mitchell, the Rev. Gilbert M. Smith, Mr. Meyer, of Guildford, Mr. Blake, Mr. James Powrie, Mr. Davies, the Rev. W. S. Symonds, Professor Rupert Jones, Mr. Simons, Professor W. King, Mr. Lechmere Guppy, Mr. T. Grindley, Dr. Leslie, Mr. J. D. Sainter, Mr. James Plant, of Leicester, Mr. S. R. Pattison, Professor Ansted, Rev. O. Fisher, Mr. E. R. Lankester, Mr. Binney, of Manchester, Count Marschall, Mr. S. P. Woodward, Mr. H. C. Sorby, Dr. Blackmore, Mrs. Strickland, Lieut.-Colonel Nicolls, Mr. Harrison, of Melbourne, and Mr. Drake, are especially worthy of my best acknowledgments. The names of some respected former contributors are absent from this list, but the friendship between them and myself continuing unbroken, welcome communications from them will most likely grace our future volumes. For my own part, the pressure of many important labours prevents such entire devotion to geology as I should like to give; but as far as my power permits, my best efforts will always be freely devoted to the interest of the readers and subscribers to this Magazine, from whom, so far as they are personally known to me, I continue to receive encouragement and support.

I would add here an earnest appeal to country collectors and provincial investigators to send notes of their doings and of the occurrences in their respective districts: not necessarily for publication, but to put me in possession of the means of securing a most valuable amount of information for the advance of science, which now is never brought before the world, and which passes resultlessly away into oblivion. When recently at Tynemouth, I observed extensive sinkings into an unusually interesting mass of boulder-drift, in the construction of a new powder magazine for the fort on the cliff within the fine old priory walls. The sections presented were in both north-and-south and east-and-west directions, the drifted materials consisting variously of sand, clay, and gravel, all containing flints and boulders of limestone, and other rocks; some, scratched and scored. The gravels commingled with runs of sand and intercalations of clay, presenting, notwithstanding their intricacy of commingling, evidences of the direction of drifting, not shown in the boulder-clay exposed along the Durham coast. My stay there was extremely limited, yet, although much engaged upon other matters, I found time to make some very rough sketches in my note-book, and to bring away my pockets full of small specimens of as many different boulders as I could. Still, what I did was not sufficient to enable me to give such an account of this remarkable cutting as it deserves; and as no trace of its existence is, as far as I am aware, shown on the face of the cliff (except, it may be, obscurely on the river side, as far as I could judge from a casual look while walking along the new jetty), there is, perhaps, little chance of such an opportunity for its examination occurring again. If, however, I had been acquainted with any geologist resident in the place, or had any one here communicated intelligence to me, I should have had the opportunity of directing operations, although at a distance, and without isiting the spot,—just as, through Mr. Elliot's kind and early inormation, I was enabled to suggest the best manner of examining he Heathery Burn Cave, and of collecting any relics that might be net with in it. Of the mammoth bones at Leicester Mr. Drake :indly gave me immediate information. Of many other similar disoveries and occurrences I have also had early notice; but my great lesire is to get still more,—indeed, as much as possible,—of such :nowledge. Every one who knows me will know that if the senders rish the information given not to be used, they have only to tell me o, and their desires will be properly respected. The value of reorting events to some special geologist, is very great, and there can e no better course than to supply such intelligence to the Editor of his Magazine, which is intended especially to record the events of he passing time. I am also pleased to have these pages made use of, as has been done by Dr. Falconer in the concluding number of this volume, as a medium of making known requirements of particular material for valuable labours in progress.

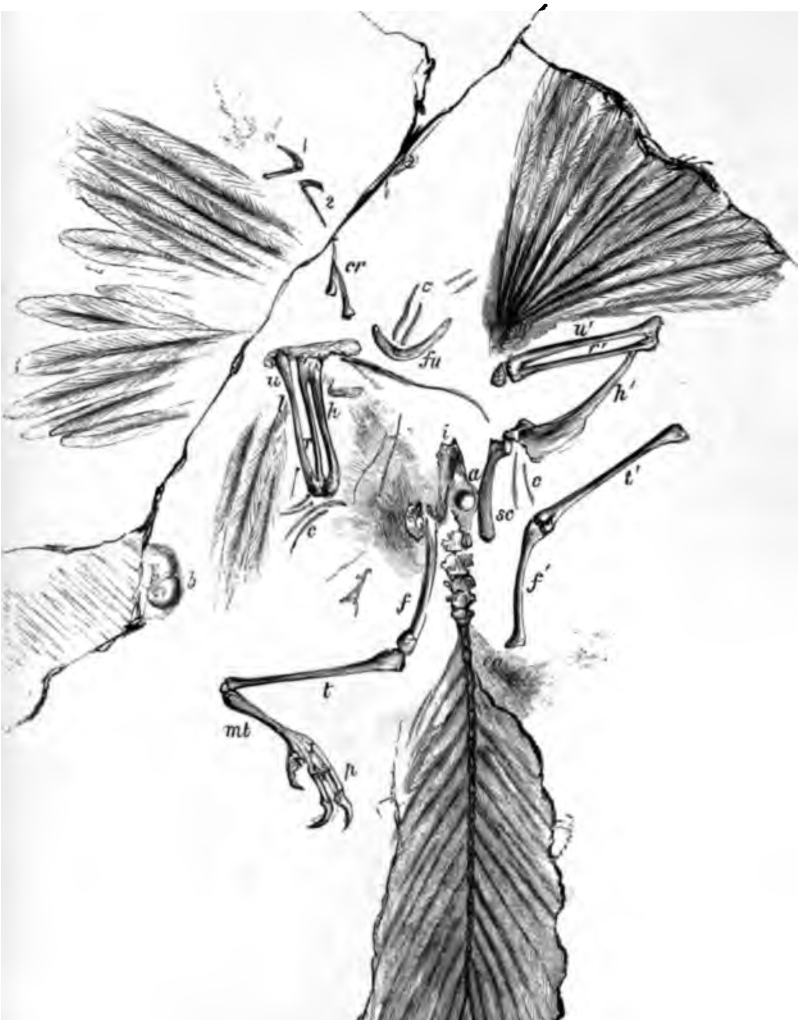
I am also gratified at the free criticism of my own articles, especially when the criticisms are as valuable as those of Mr. Scrope on my earthquake paper. In the speculations I have made, and in those I shall hereafter make, I am not actuated by any desire of innovation, but wish rather to develop discussions of many points accepted as theories, often only because they are familiar doctrines, and as often on too slight grounds.

In concluding this Preface to my sixth volume, I have only again to express my continued good wishes to my many friends.

S. J. MACKIE.

LIST OF PLATES.

LIST OF WOODCUTS.



ARCHÆOPTERYX MACRURUS (Owen).

In the National Collection, British Museum.

[redacted] Mackie del.

THE GEOLOGIST.

JANUARY 1863.

THE AERONAUTS OF THE SOLENHOFEN AGE.

At least seven geological ages ago, and there were aeronauts in those days. Not Glaishers and Coxwells, clinging to bubbles of gas at six miles high, but reptiles and birds,—the latter at least, and perhaps the former, capable of long and lofty flights. On the red sands of

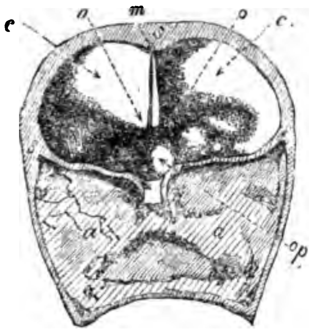


Fig. 1.—Front view of cast of brain of Carrion Crow.
cc, cerebral hemispheres; *m*, median line; *oo*, olfactory lobes; *op*, optic lobe; *ss*, section of skull; *aa*, air-cavities.

Connecticut, perhaps some two or three ages before, wingless birds had left their footprints; but nor bone nor feather has the searching eye of man yet looked upon to glean a notion of what those birds were like. Not from all the thick mass of stratified rocks deposited by lake or ocean in the long interval between the period of those impressed tracks—persistent through 2000 feet of stone—to the time when a solitary bone was entombed in the sandy mud of the Cretaceous Sea.*

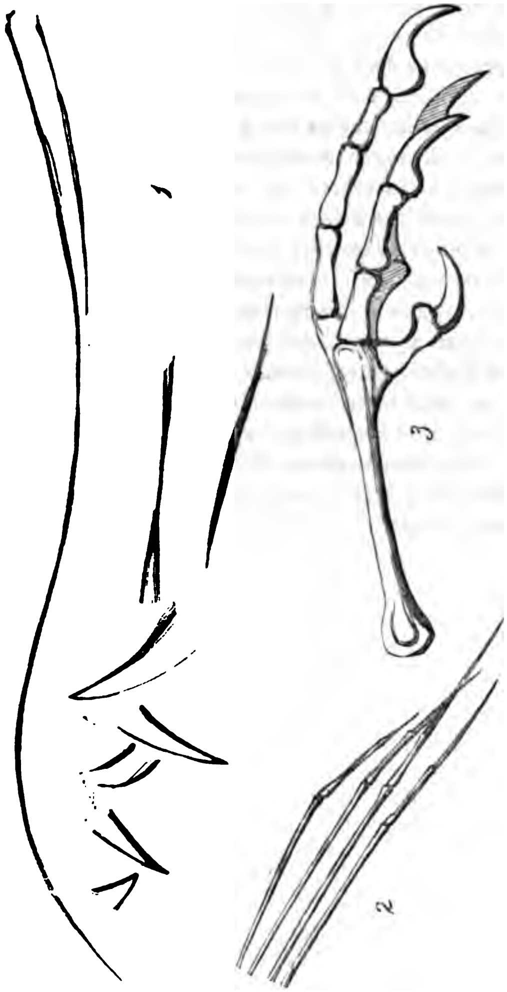
A little time ago the geological and palæontological worlds were astonished by the announcement of a feathered reptile. We recorded the reports without comment; the reason was, we could not rightly reconcile the statements to our conscientious content. We endeavoured to procure drawings, but without success; the specimen was for sale, and no doubt its value would have been prejudiced by its portraits being handed about as "*cartes de visite*" in the houses of the learned. The accounts that reached us were second-hand and by hearsay. Professor Wagner, on his death-bed, wrote the notice in the 'Sitzungberichte' of Munich, from the description of a M. Witte, who had derived his information from a sight of the specimen in M. Häberlein's possession. No doubt the mysterious announcements of a feathered reptile have enhanced the value of the Pappenheim specimen to its maximum extent, and have caused it to fetch a price which it never would have fetched had it made its *début* naturally as a bird; but its appearance in the sensation character of a feathered reptile made it a mysterious attraction, and caused it to have, in theatrical phrase, "a great run."

This singular fossil—a long-tailed bird—is now before us. At page 32 we give a report of the paper read by Professor Owen, before the Royal Society, on November 20, in which a minute description will be found. Since that time the specimen has been placed in the Gallery of the British Museum, where geologists who feel an interest in this remarkable discovery—and many unscientific persons, too, attracted to it by the notoriety it has attained—have flocked to inspect the blocks of lithographic limestone which contain the singular remains of the *Archæopteryx macrurus*.

Professor Owen and Mr. Waterhouse were both satisfied of its true ornithic nature long before the specimen was purchased for the National Collection, and we by no means regret the exceptional expenditure of so large a sum as has been given for it. It is indeed a most remarkable object, and as such, it was most praiseworthy of those officers to recommend its purchase, and of the trustees to venture the risk of blame from parsimonious economists, by acquiring it

* Found, with turtle and pterodactyle bones, amongst the phosphate nodules of the Upper Greensand at Cambridge. It is reported that there has been discovered in the so-called "Permian," but really "Rhætic" rocks of South Carolina, in which Dr. Emmons had discovered the small insectivorous mammal Dromatherium, the *os sacrum* of a bird.

that Collection which ought and does take pre-eminence amongst se of all nations, although it is packed so close as not to be a e as interesting or as instructive as it could and should be.



Figs. 1, Beak-like jaws, and 2, foot of same specimen of Rhamphorhynchus; 3, foot of Archæopteryx.—all natural size.

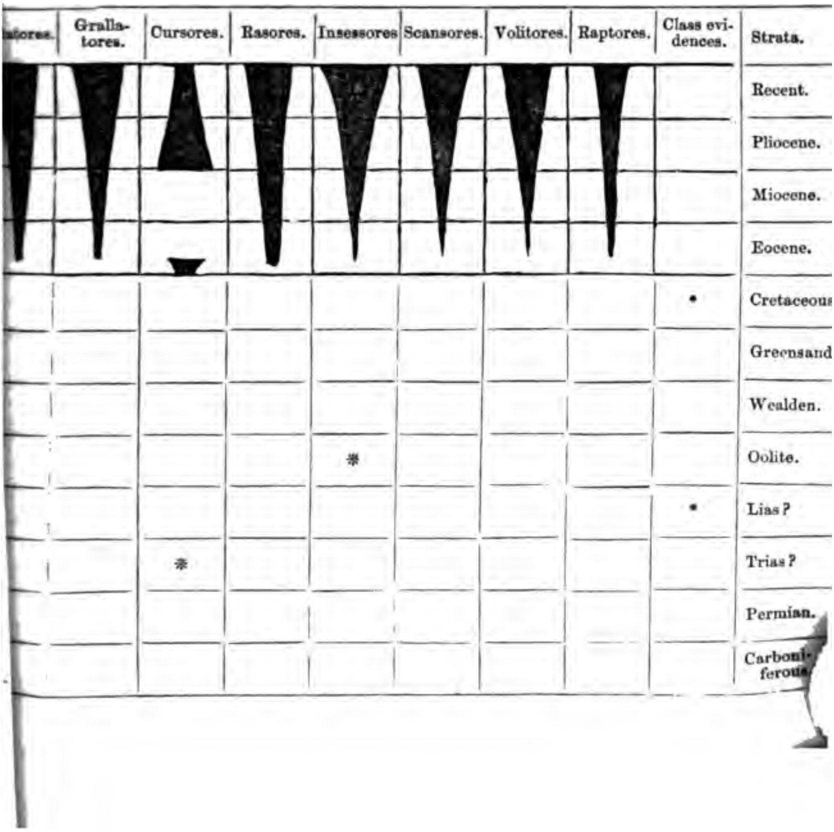
Even since the specimen has arrived and been inspected, an article our contemporary 'The Intellectual Observer,' written with much e and a complete acquaintance with the bibliography of the subject, Mr. Henry Woodward, of the British Museum, would seem to leave an open doubt that the Archæopteryx might have reptilian affinities, and that Rhamphorhynchus—the most bird-like of the Pterodactyles —might have had feathers, to preen which might have been one of the offices of a horny beak projecting beyond the few isolated teeth set near the fork of the jaws. Neither of these surmises are tenable. The Rhamphorhynchus had long strong teeth—unless we are mistaken in our interpretation of the excellent example acquired with other remarkable fossils besides the Archæopteryx in the Häberlein collection—down to the very end of the albatross-like bill or jaws (fig. 1, p. 3); while no traces of feathers have ever been met with associated with any of the numerous débris of those reptiles. As to the Archæopteryx, we are not aware that the inference originally arrived at by Professor Owen and Mr. Waterhouse, that it was a true bird, has been successfully impugned in any way. Those palæontologists who were silently present at the Royal Society's meeting, or who were "conspicuous by their absence," whose opinions we should have been glad to know, have maintained a significant silence. And the practice of naturalists in this respect seems nowadays like the practice of superior officers in Government establishments,—to find fault whenever they can, but never to give any praise.

It is most instructive to find in this fossil that more generalized type of structure presented by extinct birds of the Mesozoic age. The birds whose remains have been found in the Triassic, or as modern American geologists suggest, Liassic or Oolitic, sandstones of Connecticut, belong to the Cursorial type. These birds have been placed "at the lowest step of the scale of ornithic organization." In the abrogation or non-development of the wings, and in the number and direction of the toes, whose impressions have been afforded to us, we have evidence of a less amount of ornithic specialization in them, and a larger retention of the original vertebrate characters. In the Archæopteryx, the oldest bird of which osseous remains have as yet been found, we have also the retention of the more generalized type, but in another direction. The wings are indeed functional and capable of flight; the shape of the pectoral ridge on the humerus, and of the furculum, prove this; and the hinder extremities are modified for perching.

But in the twenty caudal vertebræ, we see the persistence of the law of generalization. In all embryo birds the caudal vertebræ are distinct: as life progresses, anchylosis goes on and they become shortened and united together. The eighteen vertebræ in the young ostrich are thus reduced to nine in the adult. In the retention of the separate vertebræ of the tail, the Archæopteryx presents an example of the persistence of embryonic or more generalized characters, and affords a demonstration of the great truth, often obscured of late years, that there exists a certain representation of the career of any single animal in the various stages through which the life system of the world has passed.

If there be any who yet entertain a doubt of the ornithic character of the specimen, and are misled by the occurrence of Archæopteryx in the Solenhofen slate, the very metropolis of Pterodactyles, to suspect any reptilian affinities for it, we hope that they will compare the hind foot of the Archæopteryx with that of any bird, and with that of the longtailed Pterodactyle (Ramphorhynchus) from the same Solenhofen beds, in the British Museum. In the birds we see the foot compact, stout, with an opposable hinder unguiculate digit, capable of prehension or of active support. In the reptile the homo-

Distribution of Birds.



logous organ is slender, without any opposable digits, and so weak that it could only have afforded a very feeble support (figs. 2 and 3, p. 3). We do see nothing in the Ramphorhynchus approaching to the powerful claws of the Pappenheim long-tailed bird.

The foregoing diagram (p. 5) will afford an idea of the distribution of the various orders of birds in Mesozoic strata.

The following table shows the distribution of some of the more striking types of Pterosauria throughout the upper Mesozoic beds.

DISTRIBUTION OF PTERODACTYLES.

	Lower Lias.	Upper Lias.	Stonesfield Slate.	Bath Oolite.	Forest Marble.	Oxford Clay and Solenhofen Beds	Coral Rag.	Kimmeridge Clay.	Purbeck Beds.	Hastings Sands.	Weald Clay.	Lower Greensand.	Upper Greensand.	Lower Chalk.	Middle Chalk.	[illegible]
Dimorphodon macronyx	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
D. Banthensis	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pterodactylus Bucklandii	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...
P. longirostris	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...
P. crassirostris	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...
P. Kochii	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...
P. medius	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...
P. grandis	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...
P. brevirostris	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...
P. Meyerii	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...
P. sp.	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...
P. Fittonii	...	...	...	...	...	...	...	...	..	...	...	...	×	...	...	...
P. Sedgwickii	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
P. simus	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
P. Cuvierii	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...
P. compressirostris	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...
Ramphorhynchus longicaudus	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...
R. Gemmingii	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...
R. Münsterii	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...

Fossil birds' feathers have not alone been obtained from the Solenhofen slate. In the Miocene rocks of Bonn, as well as in Braunkohl, near Aix, examples have been discovered.

We are sorry there is a crack in the Archæopteryx stone, and an absent piece just where we would rather not have missed it: that is, just where we suspect the head might have been. The cranium, it is true, may be still in one or other of the slabs, or it never may have been in either at all. If the bird is the rejected or lost prey of some stronger creature, the head may have been torn off, and with the attached neck, may have been left on the dry ground elsewhere, or deposited in some other place miles away. But the presence or known existence of the head would have prevented any reptilian mystery; and the current statement that the head of the Guadaloupe human skeleton in the British Museum is in a museum in South Carolina, causes one to feel a silent hope that by no similar secretive principle may we be astonished hereafter by the discovery of the head of Archæopteryx in some Continental museum. In the block there is a semicircular portion, apparently of bone, which we have suspected might be a part of the skull; but we certainly should experience something like a sensation of relief, if we were to learn that through the aid of the Museum lapidary, the head was yet existent in the matrix. However, for what we have got we ought to be thankful; and especially are our praises due to the learned Superintendent of the Natural History Department, for his able, lucid, perspicuous, and convincing interpretation of these extraordinary remains.

Since the above was written, Mr. Henry Woodward has kindly handed us the cast (fig. 1, p. 1) of the interior of the skull of a carrion crow, which has been prepared by Mr. John Evans, F.S.A., who was struck with the resemblance, as he fancied, between the brain of a bird and the little limestone concretion within the bone-mark to which we have referred.

This suggestion was so probable, that we at once instituted a close comparison, and with the assistance of Mr. Carter Blake, we believe we have decisively made out the actual parts of the brain indicated by that seemingly unimportant protuberance, and for the apt means of the determination of which too much praise cannot be given to Mr. Evans. The story then, as we read it, is that a portion of the skull, and what may be termed the fossil brain, still remain in the slab. We will now attempt to describe this protuberance in the limestone as a fossil brain. The anterior part of the brain is presented vertically to the spectator, or stands out perpendicularly from the face of the stone. At its apex the site of the olfactory lobes are very evident, as is also, running down towards them, the median line.

The inturned edge of the cerebral hemispheres is also easily made out, and some trace of the optic lobe beneath the brain may perhaps be detected. Round the back of the counterpart cavity, in the opposing slab of stone, a portion of the transverse section of the back of the skull, showing the bony intercerebral ridge, is to be met with.

There is near this space a conchoidal fracture, which Mr. Blake thinks might be the impression of the parietal and frontal bones; but although we believe these bones were within the region of this space, we think the conchoidal fracture has been produced by artificial means. The proximity of these cerebral and cranial relics to one of the missing pieces of stone, renders it highly desirable that some pains should be taken to obtain it, as the beak of the bird's head would have probably projected upwards and inwards into it, as it covered the brain in the slab containing the chief remains. That is to say, the Archæopteryx's head would have rested on its back on the mud, with possibly one or two of the cervical vertebræ attached to it, the beak thus projecting directly upwards, exactly as we usually find those of dead gulls and other birds on our present shores.

This evidence goes far to support the admirable inferences of Professor Owen, as the fossil brain presents true bird's characters, and can thus be perfectly distinguished from the very peculiar form of brain in reptiles.

EXPLANATION OF PLATE I.

c, costæ; *sc*, scapula; *h*, humerus; *u*, ulna; *r*, radius; *cr*, carpals; *i*, ilium; *f*, femur; *t*, tibia; *mt*, metatarsus; *p*, phalanges; *ca*, cauda (tail); *b*, fossil brain; *a*, acetabulum; 1 and 2, carpal hooks.

ON DIDYMODON,* A NEW GENUS OF MINUTE ARTIODACTYLE MAMMALIA, FROM THE EOCENE OF VAUCLUSE.

BY CHARLES CARTER BLAKE, ESQ.,

Lecturer on Zoology at the London Institution.

Since the original foundation of the genus Dichobune by Cuvier,† and the critical observations made thereon by Owen,‡ the national collection has continued to receive new accessions, indicating the existence of a certain range of variation in the molars of that genus.

The specimen (No. 30673) in the British Museum collection, is figured in Plate II., by Mr. Mackie. It consists of the three molars of the right side of a species of small quadruped closely resembling Dichobune. The length of the fractured ramus containing these teeth, of which the inner aspect is exposed to the observer, mea-

* From δίδυμος, *twofold*, and ὀδοῦς, *tooth*.
† 'Ossemens Fossiles,' vol. v., *passim*.
‡ Quarterly Journal of the Geological Society, vol. xiii. 1857, p. 254.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

1. DIDYMODON VAUCLUSIANUS : 2. Top View of Molars.
(From the specimen, nat. size.)

3 EQUUS MACROGNATHUS (one-fourth linear).

4. EQUUS DEVILLII (one-fourth linear).

J. Mackie del.

sures 27mm.; its greatest vertical depth between the penultimate and last molar being 11mm.

The last molar (*m* 3) measures 7mm. in length, and 4 in breadth. Its form is quadricuspid; the two outward cusps being least eroded; from the ectoposterior cusp is developed a slight basal talon, extending towards the entoposterior cusp, which is the smallest of the four, pyramidal, and acuminate; the entoanterior cusp is larger, and is tipped with a small exposed ring of enamel; the ectoanterior cusp is much worn; there is no trace of the distinct hinder lobe of Xiphodon, which lobe in the Dichobune (sp.?) from Hordwell, marked 29714§ in the British Museum, exhibits a well-marked bicuspid division, having the effect of rendering the ultimate molar in that specimen virtually hexacuspid, to a greater extent than in the *Dichobune ovina.*

The second molar, 7mm. in length and 4 in breadth, has also four cusps; the ectoposterior one being the most worn, and having a distinct basal posterior talon running from it to the foot of the entoposterior cusp; the two anterior cusps are much the highest, a sabre-shaped band of enamel running from the base of the ectoanterior cusp nearly to the summit of the entoanterior cusp.

The fractured first molar has the posterior half broken away beneath the maxillary alveoli; it exhibits the traces of a distinct fang; its anterior portion shows an eroded surface, affording a slight resemblance to the bicrescentic contour of the same part in Dichobune.

I have compared this fossil with the specimens, figures, and descriptions accessible to me of Dichobune, Xiphodon, Cainotherium, Hyægulus, Amphitragulus, Tapirulus, Aphelotherium, Dichodon, Heterohyus, Acotherulum. Of the latter genus, which closely approached Didymodon, Gervais remarks as follows:—"The *Acotherulum saturninum* appears to be related to the Dichobunes; but its hinder molars have only 2 tubercles on each ridge, and in this relation it has most analogy with Palæochærus and Chœromorus, for Dichobune has 3 tubercles on the anterior ridge." Gervais figures, on his 24th plate, the 4 antepenultimate superior molars, and 3 inferior molars of the left side. These were obtained from the lignites of Débruge, near Apt. The lower teeth differ from Didymodon, should my interpretation of their homologies prove correct, by having a distinct quinquecuspid pattern to the 2nd molar, whilst the 3rd molar exhibits (so far as the fractured tooth, half of which is broken away, can yield any decided information) no trace of the well-defined dichotomous division of its posterior portion in the new form.

In *Heterohyus armatus* the last molar is "tuberculeuse, très-émoussée, simulant en avant une fausse colline transverse un peu oblique" (Gervais, pl. xxxv. p. 7), the difference existing between the penultimate and antepenultimate molars of the two forms precluding

* This specimen (No. 29714) consists of the last and half the penultimate molars of a Dichobune; the former measuring 14 mm. in length and 8 mm. in breadth. In the specimen marked 29856 the cusps on the posterior lobe are worn, the breadth as well as the length of the teeth being much smaller than in 29714.

the supposition that any degree of wear could have worn the teeth of Didymodon down to the condition of Heterohyus.

In Dichodon the well-marked bicrescentic form of the molars, and the absence of the tendency to develope 4 pyramidal cusps, with traces of a posterior talon exhibited in Didymodon, render further comparison unnecessary.

In *Aphelotherium Duvernoyi*, Gerv., derived from the Paris gypsum, which bears many curious points of resemblance to Didymodon, and which I only know by Gervais' figures, the view of the 1st and 2nd molars from above (pl. 34. loc. cit. No. 136) presents a totally dissimilar aspect. The two ridges into which the worn molar there depicted is divided, are more oblique than in Didymodon, while the 3rd molar, which in figs. 13 and 13[a] is seen concealed in the alveolus, exhibits three distinct ridges.

Tapirulus hyracinus, of Gervais, is another closely allied form. In Gervais' definition of the genus,* he says, "Lower posterior molars with two very distinct transverse ridges, incompletely united by a weak keel perpendicular to their axis, instead of being oblique; a strong posterior talon; that of the last resembling a third ridge less large than the two others." The posterior talon of the hinder molar in Gervais' plate (34, 3 and 3[a]) projects far more in a posterior direction than the presumed homologous rudiment in the Didymodon, and this difference is observed in a less degree in the preceding tooth. The ridges in Tapirulus, transverse to the tooth's axis, are too well marked to render it likely that they may have been produced by the worn enamel-folds of the denuded cusps in an old Didymodon.

Hyægulus collotarsus, of Pomel, which in the other dental characters of its lower jaw agrees with the typical Cainotheria,† differs from them, according to that writer, in the deeper division of the inner points of the second ridge of its lower molars. The figure of the species which Gervais presumes to be identical with Hyægulus, and names *Cainotherium Courtoisii* (pl. 35. f. 4, and pl. 34. fig. 6) distinctly shows a third posterior ridge divided apparently into two cusps to the third lower molar tooth. In Chœromorus, from the accessory cusp of the last molar has a tendency to a ternate division, which is seen in the eroded molar of *C. simplex*, and more prominently in *C. mammillatus*. In Palæochœrus, from the accessory cusp, seen laterally, is as high as the two other cusps of the last molar, and even higher than the two median cusps.

Cainotherium, Xiphodon, Dichodon, and Dichobune, each exhibit the same third lobe to the last molar as in Dichodon,‡ repeating the characters of the two previous lobes of the same tooth. In *Dichobune ovina*, this lobe, probably owing to the less degree of wear in the specimens, assumes more the character of an elevated unequal cusp, which, however, as Prof. Owen has pointed out, "plainly con-

* Loc. cit. p. 56.
† 'Geologist,' vol. v. 1862, p. 32 and p. 124.
‡ Owen, 'Quarterly Journal of the Geological Society,' vol. xiii. 1857. pl. iii. fig. 3. The lobe is here marked *g*.

sists of a pair of cones; the inner one being rudimentary, the outer one of the same anteroposterior extent as the normal outer cone, but lower and thinner, and oblique in its position." It is this accessory lobe, which in the ruminant division of Artiodactyla is strongly developed.

In the *Amphitragulus communis*, from the lacustrine marls of Ronzon, near Puy-en-Velay, the accessory lobe is more outwardly and obliquely developed than in Didymodon, and the same remark applies to the *Xiphodon gracile*.

I have been slowly led to the conclusion that the specimen in question is not to be identified with any of these genera, from the lower Tertiary deposits. At the risk of burdening the overloaded terminology of the fossil herbivorous Ungulates with a new name, I have been led to give it generic distinction. The specific name *Vauclusianum* is derived from the locality.

Should it be placed amongst the Artiodactyles, under which order it seems to be categorized, its place will be found near to Dichobune, Acotherulum, and Aphelotherium. At the same time, there is a certain resemblance to Tapirulus, which should preclude us from confidently denying that it may have perhaps formed part of the family of small pachyderms, congeners of the great Lophiodontoid Perissodactyles.

ON THE AGE OF THE DARTMOOR GRANITES.

By W. Pengelly, F.G.S.

Though our science has risen above the stage from which she taught that all granites are parts of the original crust of the earth; though she has advanced so far as to doubt whether, in all cases, the granitic was the first phase of rock-existence which the materials composing it assumed, and to entertain the question whether such rocks may not be the extreme form of metamorphism, which has obliterated all traces of an earlier condition; and though she may prudently decline to point out, in the large circle of her rocky acquaintances, one mass of crystalline unstratified rock which, as such, can be proved to be older than some known beds of mechanical origin; it remains to be the rule rather than the exception to meet with persons, frequently well-informed, and not without an interest in geology, who still cling to the notion, or allow it to cling to them, that every mass of granite is a *primitive* rock, in the strict chronological import of the term; and represents a period in the earth's history prior to the possible existence of sedimentary strata, or of organized beings. Indeed the opinion that granite is, in all cases, a *primary* rock, has so large a place in the public mind, that one might prudently hesitate before throwing such a question as "What is the age of the Dartmoor granite?" before any audience having a very large admixture of the popular element.

It has long been known that the age of the granitic rocks of Dartmoor can be safely limited on the side of antiquity. That they are less ancient than the culmiferous beds of North and Central Devon has been established on satisfactory evidence produced by various observers.

Sir Henry De la Beche, in his 'Report,' says, "The intrusion of the Dartmoor mass was certainly after the deposit of the carbonaceous series of North Devon, be the age of that series what it may; it thrusts the southern portion of this series northwards to Oakhampton, cuts off the ends of trappean bands and of associated beds of grit and shale near Cristow and Bridford, and sends veins into it in the valley of the Dart, at the junction of the two masses of rock."*

Professor Sedgwick and Sir R. I. Murchison, in their paper on "The Physical Structure and Older Stratified Deposits of Devonshire," say, "Granite veins, passing from the eentral mass into the superimposed stratified rocks, are found on all sides of Dartmoor. We have seen them above Ivybridge, injected amongst the oldest slates of Devonshire; and near Oakhampton we have seen them in like manner, penetrating the culm-measures; and they are finely exposed in the beautiful gorges of the Teign and the Dart, where those rivers descend from the granite to the culmiferous series. These examples, to which we could add many more, are sufficient for our purpose. Now these veins, taken in general, are mere prolongations of the central granite, inseparable from it, and contemporaneous with it; they cannot therefore (as the granite is one mass) be contemporaneous with stratified rocks of different ages. Consequently they are true veins of injection, and the granite was protruded at a time posterior to all the other stratified systems."† In another part of the same paper these authors go on to say, "It appears that the rocks of Devon and Cornwall belong to three periods of formation. The oldest includes the various groups of slate rocks, and at least a part of the associated traps. The next includes the culm series, the upper division of which contains fossils identical with those in the upper division of the coal measures. The granite belongs to the newest period."‡

Mr. Godwin-Austen, in his paper on "The Geology of the South-East of Devonshire," speaks of similar granite veins, and, in a somewhat qualified manner, confirms the opinion of the authors just quoted respecting the chronology of the granite; stating that "The observation of Professor Sedgwick and Mr. Murchison, above quoted, as to the age of the Dartmoor granite, applies necessarily to the schorly portion alone, which comes in contact with sedimentary deposits, for the entire mass is not of the same age." He then gives a figure of a section, "showing the manner in which the usual porphyritic granite has intruded itself among such as had already become compact and jointed, and containing schorl," and adds, "Again, this porphyritic

* 'Report on the Geology of Cornwall, Devon, etc.,' p. 165.

† Geol. Trans., 2nd series, vol. v. part iii. p. 686.

‡ Geol. Trans., 2nd series, vol. v. part iii. p. 687.

and micaceous granite is traversed by elvans of a compact, fine-grained stone, presenting no distinct crystallization of any of its constituents, and they have evidently been protruded posterior to the consolidation of the rocks in which they occur. The facts here noticed warrant the conclusion that it (the Dartmoor region) contains granite of three distinct ages." *.

More recently Mr. Ormerod, who most assiduously uses the facilities which his residence at Chagford gives him for the study of this subject, has mentioned several localities where granite veins occur in the carbonaceous rocks; he states that, at one place on the river Teign, "the veins throw off branches into the adjoining rock, and vary in thickness from a thin filament to a breadth of about eighteen feet." He adds, that "the veins contain portions from the adjoining carbonaceous beds, sometimes so slightly removed from the original position that it can be traced; in the larger veins some of the masses are rounded, as if they had undergone attrition, but some (about a cubic foot in size) still preserve their angularity." †

There can be no doubt, then, that the Dartmoor granites are less ancient than the culmiferous beds of North and Central Devon. Our next business is to find, if possible, a *modern* limit to their age.

Amongst the stratified rocks of the county, the red conglomerates and sandstones, which give such a character to the cliffs and soil of South Devon, succeed, in ascending order, the culmiferous beds already spoken of; they are the next more modern. Now conglomerates may be regarded as natural museums, in which we are likely to find specimens of all pre-existing rocks occurring in their neighbourhood, and the fact that any rock existing in a given locality has no representative fragment in an adjacent conglomerate, though merely negative evidence, would not be a bad, though by no means an unimpeachable, basis on which to found the opinion that such rock is more modern than the conglomerate thus destitute of any indication of its existence. Such an opinion, however, would, of course, be overthrown by the first fragment which further research might bring to light.

Sir Henry De la Beche says, "The evidence of the Dartmoor granite having occupied its present relative position, anterior to the early part of the (New) Red Sandstone, is not always so clear as could be desired; for among all the pebbles of the red conglomerate extending from Torbay to Exeter, we have not been able to detect any portion of it, though the granite ranges so near that part of the red conglomerate. In the tongue of red sandstone and conglomerate which runs from Crediton, amid the carbonaceous series by North Tawton and Sampford Courtney to Jacobstow, we have, however, detected pebbles like some varieties of Dartmoor granite." ‡

It must be confessed that this is not a very pronounced opinion in favour of the North Tawton pebbles being of Dartmoor origin. In

* Geol. Trans., 2nd series, vol. vi. part ii. p. 477.

† Quart. Jour. Geol. Soc., vol xv. p. 192.

‡ 'Report on the Geology of Cornwall, Devon, etc.,' p. 166.

his paper, however, in the 'Memoirs of the Geological Survey of Great Britain,' the same author speaks of them in a somewhat more decided tone as follows:—"Among the pebbles of the new red sandstone conglomerate nearest to Dartmoor, granite from it is scarce, some varieties having been only found on the north, by Tawton and Sampford Courtney." *

Geologists, however, have by no means all concurred in this opinion respecting the so-called "granite pebbles." Thus we find Mr. Godwin-Austen—and probably few geologists are so intimately acquainted with the district—in his paper already quoted, expressing himself thus:—"In the study of detritic formations the identification of mineral fragments becomes of almost equal importance with that of organic remains; in the present instance they afford only negative testimony; but as, from the absence of volcanic fragments in the conglomerate Eocene beds of Central France we infer the relative age of the volcanic outbursts of that region, so, as no granite pebbles have been found among the various materials of which the new red conglomerate is composed, we may conclude, that at the period of its accumulation the granite of Dartmoor could not have been exposed, particularly when we bear in mind that the two formations are at present separated only by the valley of the Teign.

The beds of the greensand of the Haldons and the Bovey valley, in the thin mica, sharp quartzose crystals and seams of felspar clay, suggest that they may have resulted from a decomposed granitic district; but here again, although fragments of all the older rocks occur in the conglomerate beds at the base of the greensand, granitic pebbles are altogether wanting; nor do we meet with them until we arrive, in ascending order, at those superficial accumulations which cap the Haldons, when they appear in great abundance associated with rolled flints, and worn like marine shingle. Possibly, then, the rise of the granite of Dartmoor, in its present form, may belong to a period comparatively recent." †

Sir Charles Lyell says, "The granite of Cornwall is probably of the same date," (as that of Dartmoor) "and therefore as modern as the carboniferous strata, *if not much newer*."‡ This expression is evidently very guardedly indefinite, much more so probably than would have been the case had that distinguished author been satisfied that the pebbles in question were really granite.

Happening, a few years ago, to be at North Tawton, I mentioned the subject to Mr. William Vicary, then resident there. He immediately took me to the conglomerate, and in a few minutes extracted two or three pebbles, which we both regarded as certainly of Dartmoor derivation. I am not sure that either of us would have contended that they were true granite, if by that term we are to understand a mass made up solely of distinct crystals of felspar, quartz, and mica; nor, thus defined, would any one be prepared to call every-

* Memoirs Geol. Survey, vol. i. p. 228.

† Geol. Trans., 2nd series, vol. vi. part ii. p. 478.

‡ 'Manual of Elementary Geology,' 5th ed. p. 587.

thing granite which occurs in the true Dartmoor country. Sir Henry De la Beche says, "The granite of Dartmoor is, as a whole, a coarse-grained mixture of quartz, felspar, and mica, the latter sometimes white, at others black, the two micas occasionally occurring in the same mass. It is very frequently porphyritic, from the presence of large crystals of felspar, and here and there schorlaceous; but the latter character is chiefly confined to the outskirts, where the Dartmoor granite adjoins the slates. The schorl not unfrequently occurs in radiating nests of variable size and abundance. A complete passage may generally be traced between the compound of schorl and quartz, usually termed schorl rock, and the ordinary granite. The mica usually disappears as the schorl begins to be abundant, and sometimes, though not very commonly beyond limited areas, the granite is a mixture of mica, schorl, felspar, and quartz, in nearly equal proportions. After the absence of mica the next mineral which commonly disappears is the felspar, leaving the compound a mixture of schorl and quartz, the former sometimes occurring in radiating nests in the latter; but more commonly the two minerals form an aggregate in nearly equal proportions." *

This, though a comprehensive, is by no means an exhaustive description; considerable dissimilarity exists in the size of the aggregated crystals in different specimens; nodules, apparently segregative, sometimes occurring in the substance of the ordinary granite, might, from the fineness of their grain, be almost mistaken for sandstone; indeed, I not long since heard them appealed to as proofs of the metamorphic origin of granite. "Here," said the appellant, "are unaltered remnants of the old sandstone rocks, which, with these exceptions, metamorphism has converted into granite." I do not quote this for the purpose of endorsing it, but simply to show the general dissimilarity of the nodules to granite proper. Excepting their darker colour, they reminded me much of the granite veins which pass through the older granite of Goatfell, in the Isle of Arran; nevertheless they are not veins but nodules, and capable of being extracted, as such, from the granitic mass containing them. Good examples of such nodules may be seen, amongst other places, at Shaptor, about two miles from Bovey Tracey, where I succeeded in extracting two good specimens. They consist of very fine grains of quartz and schorl, in about equal quantities, or with the latter somewhat preponderating.

The observer who enters a Dartmoor quarry soon discovers that granite is by no means weatherproof; the effect of the weather is very discernible, fully a foot or more within the exposed surfaces; a more or less dark or ferruginous-looking band, of about the width just mentioned, graduates into the unchanged rock, and suggests that small fragments might, through long exposure and rough usage, undergo a very considerable change of aspect.

The boulders which occur so abundantly in the beds of the Dartmoor rivers and rivulets are found to be more or less changed in

* "Report," p. 157.

character; were it not that every gradation can be readily supplied, it would be sometimes, at least, a little puzzling to recognize a member of the Dartmoor family of rocks in the fragments met with along the river-courses, and which have yielded to the various influences to which they have been exposed since leaving home. It is these travelled masses which must tell us whether the red conglomerates of Devonshire contain specimens derived from the central upland of the county; and I have no hesitation in believing that every one approaching the subject in this way would pronounce the North Tawton pebbles to be of Dartmoor origin.

In August last (1861), I met Mr. William Vicary,—who now resides at Exeter, and is devoting himself, with great diligence and success, to the geology of that neighbourhood,—and again introduced the subject of the North Tawton pebbles; on which he informed me that he had recently found unmistakable Dartmoor fragments in the red conglomerate of Great Haldon, a well-known hill about five miles south of Exeter; and that a friend, to whom he had mentioned his discovery, had called his attention to the following passage in Brice's 'History of Exeter.' The author is describing the Haldon red conglomerate, and says, "*In it* we have often found rounded pebbles, and *pieces of granite of the same form.*"*

A fact of so much interest was not to be neglected; accordingly we took an early opportunity of starting for Haldon. Passing through Alphington and Kennford, and leaving the great road from Exeter to Plymouth by Chudleigh and Ashburton, on the right, for that which passes over Haldon, in a more easterly direction, to Newton-Bushel, we reached our ground, about five miles and a half from Exeter; and Mr. Vicary at once pointed out one or two well-marked fragments of the true Dartmoor series of rocks in the conglomerate, but so far decomposed and disintegrated that it was impossible to extract them in their integrity; a further search was soon rewarded with several less perishable specimens, amongst them representatives of each kind of granite recognized by Mr. Austen in the Dartmoor country; namely schorlaceous granite, porphyritic granite, and elvan.

On our way back to Exeter, we detected two or three well-marked specimens near Peamore, about two miles and a half from the city.

That part of Haldon at which the pebbles are met with is about five miles, in a straight line, from the nearest point of the granite; the fragments found at Peamore must have travelled something more than a mile further. The red conglomerate approaches to within about the same distance from the granite at Newton-Bushel, and several other places; the fact, if it be one, that no such pebbles have been found in these localities, should stimulate to further and careful search; and if, after all, they really do not exist there, it need not be a matter of very great surprise; changes in the physical geography of the district, amply sufficient to account for it, may have occurred since the period of the red conglomerate.

I may state here that during the spring of the present year (1861),

* 'History of Exeter,' by Thomas Brice, 1802, p. 114.

Dr. Daubeny pointed out to me certain pebbles, which he thought granite, in the red conglomerate at Livermead, in Torbay; my own impression, however, is, that they are trap. I do not, of course, suppose that my opinion would be of any value when opposed to that of the eminent man just named, especially on a point of this kind. I merely mention the fact, to show that I have not allowed a strong bias, supposing me to have one, to overrule my judgment; or I should have quoted the Livermead pebbles as granitic, on Dr. Daubeny's authority.

But waiving this point, I cannot regard it as certain that the red rocks of Torbay and of the South Devon coast generally are entirely destitute of Dartmoor detritus. Every one who has paid attention to the sandstones there, must be well aware that in many cases they are eminently micaceous; this is very noticeable at the Corbons and Livermead Head, in Torbay, where every newly exposed surface glistens with an almost metallic glance, from the presence of numerous large scales of black mica; doubtless a result of the destruction of a large amount of pre-existing rock, of which mica was a constituent. It is, no doubt, true that certain gritty members of the older rocks of the county sometimes contain scales of mica; it seems impossible, however, that these can have been the source of those found in the Red Sandstone, for, so far as I am aware, they are, in the first place, always small instead of large; and, in the second place, invariably white instead of black. On the other hand, in a passage already quoted from Sir H. De la Beche's "Report," it is stated that the mica of the Dartmoor granite is sometimes black. Nor is it difficult to understand that whilst pebbles and boulders might be unable to force a passage to what is now the South Devon seaboard, comparatively small thin flakes of mica succeeded in accomplishing the journey. The fact, however, that nodules of micaceous trap occur in the conglomerate, renders it manifestly unsafe to insist on the granitic derivation of the scales in the sandstone.

If it be true that granite pebbles occur at Sampford Courtney, North Tawton and Haldon, but do not exist on the southern coast of the county,—in other words on the north and north-east, but not on the east, of Dartmoor,—may we not have, in this fact, an indication of the prevailing direction of the most powerful currents, or other agents of transportation, in this part of modern Devonshire during the Red Sandstone era?

The following appears to be a strikingly parallel case. The low plain known as Bovey Heathfield, in Devonshire, is covered with a very coarse gravel, and surrounded, on almost every side, by hills of considerable elevation; on the north and west the granite heights of Dartmoor, fringed with traps and metamorphic rocks; on the north-east and east the greensand hills of the Haldons, capped with vast accumulations of flint and chert; and on the south a range of hills, extending from Newton towards Ashburton, consisting of Devonian limestone and associated rocks. The Bovey gravel consists almost entirely of Dartmoor material, a flint or chert fragment occurring here and there at very long intervals. I will not undertake to say that it contains no limestone detritus, but I certainly have never seen or heard of a fragment of the kind, though I have frequently, and with considerable care, examined the gravel, and questioned the men who work amongst it; yet the limestone is one of the oldest rocks of the district. Accepting this negative evidence as trustworthy, it simply proves that the direction of transportation was not from the south; not that the rocks in that direction have been called into existence since Bovey Plain received its surface covering.

But to return. The facts now in our possession appear to compel the belief that the Dartmoor granites were not in existence when the carboniferous rocks of Central and North Devon were deposited, but did exist and were exposed at the surface in the red conglomerate era. In relation, then, to the stratified rocks of the county, we have both an ancient and a modern chronological limit for the granites. Our next question is, What are the places of the limiting rocks in the chronological series of the geologist?

There is no difficulty as to the answer respecting the *ancient* limit —the carboniferous beds. Professor Sedgwick and Sir R. I. Murchison, in their paper already quoted, say "the *flora* of the upper culms, as far as it has been ascertained, agrees specifically with the known flora of the Carboniferous period. We think we have strong direct evidence to establish our position that the upper culm strata of Devon are the geological equivalents of the ordinary British coal-fields."* The same authors, in a passage previously quoted, state that "the upper division of the culm series contains fossils identical with those in the upper division of the coal-measures."

It is not so easy to settle the *modern* limit—the red sandstones and conglomerates. That they belong somewhere between the Carboniferous and Jurassic systems there can be no doubt, since they overlie the culmiferous beds and pass under the Lias; but whether they are Triassic or Permian has not been considered so certain as could be desired. They are entirely destitute of fossils, excepting those only which occur in the calcareous pebbles, which, of course, belong to the age of the parent limestone. The sandstones are evidently of littoral origin; their surfaces frequently display *wave*-ripple marks, desiccation cracks, and impressions of rain-drops; but no footprints or other organic traces have ever been detected on them; they apparently contain no palæontological evidence whatever of their age.

More than one eminent geologist has been struck with the angular character of the fragments composing the so-called conglomerate, —more correctly, breccia,—and has remarked that in its physical character and general appearance the formation is rather Permian than Triassic. It is, however, as is well known, coloured on our geological maps as being on the horizon of the lower Trias. I am not without hopes than the granite pebbles so frequently mentioned here may help to show that this decision is correct.

* Geol. Trans., 2nd series, vol. vi. part iii. p. 682.

Whatever may be our opinion respecting the origin of granite,—whether we hold it to be a strictly igneous or a thermo-aqueous product, an original or a superimposed phase of rock existence,—we are probably all agreed that it was formed in plutonic depths, a hypogene formation requiring for its elaboration enormous pressure, and therefore at least commensurate resistance in a superincumbent crust. In the case before us, the overlying mass existed at the close of the Carboniferous period, or the granitic form could not have been assumed by the Dartmoor rocks; and it must have been removed and the granites laid bare before the conglomerate era, or fragments of the latter could never have found their way to Haldon.

Mr. Sorby estimates the pressure under which the St. Austell granite was formed as equivalent to that of 32,400 feet rock; that of the mean of the Cornish granite at 50,000 feet; and that of Ding-dong Mine, near Penzance, at 63,000 feet. He gives no estimate for Dartmoor, but taking his *lowest*, the St. Austell figures, we have a pressure equivalent to that of a pile of rock six miles in thickness; but, since the pressure was probably due to the expanding power of some agency acting beneath or within the granitized mass,—requiring resistance and not pressure, strength and not weight in the overlying crust,—we will content ourselves with a small fraction of this: nevertheless there must have been a solid crust of vast thickness for denudation to strip off before a granite pebble could have travelled to Haldon. Even if we suppose that some paroxysm uplifted the granite in a solid state, so as to shiver the overlying masses, and thereby facilitate the work of denudation, still the removal of such a mass of rock must have required an amount of time so vast, that it seems totally impossible to regard the red conglomerates and sandstones as more ancient than the Lower Trias; and, even thus, what an incalculably great value does this stamp on the units of geological chronology!

The supposition, however, that the granite was thus thrust through the overlying rocks is altogether improbable, for the latter appear to have shared in all the great movements which the former may have undergone. According to Sedgwick and Murchison, the granite veins in the older surrounding rocks, "taken in general, *are mere prolongations of the central granite, inseparable from it*, and contemporaneous with it."*

The time of denudation, moreover, vast as it probably was, formed but a fraction of the period separating the culmiferous and red rocks. At the close of the Carboniferous period there was no Dartmoor granite; after this we have, according to Mr. Godwin-Austen, the formation of three distinct masses of granitoid rocks, very distinguishable from one another, clearly results of dissimilar conditions within the same area, and therefore referable to different times. The *schorlaceous* granite was first formed; this was succeeded by the *porphyritic* variety when the first had become compact and jointed; afterwards the *elvans* were formed and obtruded into the

* Geol. Trans., 2nd series, vol. v. part iii. p. 686.

porphyritic mass subsequently to its consolidation;* then followed the period of denudation; but all this was anterior to the commencement of the conglomerate era, since pebbles of each kind of granite occur in the Haldon beds, which belong to the base of the red rocks of Devonshire.

Should it be objected that the granites, though requiring great pressure, were not necessarily formed beneath an accumulation of *rocky* matter, but possibly under an equivalent depth of sea, it does not appear that this can greatly affect the chronology of the question, at least by way of abridgment. Passing by all other considerations, we should require a lapse of time sufficiently great to carry down the area of, at least, central Devon, from the relatively high level at which the culmiferous beds were certainly deposited, to an ocean depth of enormous profundity; and time enough, too, after the plutonic masses had, at this depth, been called into existence, to bring it up again within the influence of the waves, so that they might detach samples of each kind of granite, to be transported to where the conglomerate was being formed.

Take what view of the case we may, an enormous period between the culm and conglomerate series appears inevitable; a period during which great changes were effected within, and on, the crust of the earth —changes which, from their nature, could not have been contemporary, but must have followed each other in a definite and ascertained order, and the greater part of which at least convulsion or catastrophe must have been powerless to produce or hasten.

Unless we assume that a great chronological interval elapsed between the Carboniferous and Permian periods,—and to this palæontology appears to give no sanction,†—the facts of the case before us seem to require the belief:—

1st. That the granites of Dartmoor are not older, at most, than the close of the Carboniferous period.

2nd. That they had been stripped bare by denudation when the materials of the red conglomerates were being brought together.

3rd. That the red conglomerates and sandstones are not of higher antiquity than the Lower Trias.

4th. That the Permian period was of great duration.

ON THE MODE OF FORMATION OF LIMESTONE BANDS.

By Rev. J. D. La Touche, *Stokesay, Salop.*

With a Note by J. W. Salter, F.G.S., A.L.S.

The existence of layers of limestone at various intervals among the rocks, while in the intermediate strata there is a remarkable defi-

* Trans. Geol. Soc., 2nd series, vol. vi. part ii. p. 477.

† Page's 'Past and Present Life of the Globe,' p. 114.

ciency of that substance, is a fact which I have not seen hitherto satisfactorily accounted for, but of which we may hope to find some rational explanation.

The surface of the country in Shropshire, where these rocks abound, may be roughly described as consisting of ridges of hills, of which one flank is steep, the other shelving; the crest of the ridge being composed of a band of limestone, which, by its hardness, has evidently resisted the action of the denuding forces which have worn away the softer strata, and thus have formed the valleys.

I. Now, while the proportion of lime to earthy matter is immensely great in these comparatively thin bands which form the crests of these hills, it is as remarkably deficient in the rest of the strata; in the one case, the fossils, and their bed also, are often found to be a mass of carbonate of lime, while, in the other, not only the substance in which the fossils are deposited is deficient in that substance, but the fossils themselves have frequently lost the lime which once, beyond all doubt, entered into their composition.

II. Besides these remarkable and extensive layers of limestone, we meet occasionally with minor bands of more limited extent, and in some places with *nodules* of limestone varying from an inch or two to eighty feet in diameter.

Such, briefly, are the facts of the case, and attempts have been made to account for them in the following manner:—1st. It has been supposed that occasionally, during the deposition of the strata, a sudden but transitory development of carbonate of lime took place in the waters of the primæval seas—an hypothesis which seems to be at once refuted by the existence of the nodules I have alluded to: and, 2ndly, a more plausible theory, that these bands have been formed in a manner analogous to coral reefs; that the animals of which the fossils are the remains, secreted vast quantities of lime; that an accumulation of that substance took place around them, and so ultimately a layer of limestone was formed.

The last hypothesis seems to me also unsatisfactory, for while it may account for those cases where fossils are enormously abundant, as in some parts of the Wenlock limestone, it seems to fail in those where they are absent; and such instances are frequent. We find large masses where fossils are rare, and yet that they have not been destroyed or absorbed in any way is proved by the existence of occasional specimens in a very perfect state. Witness such fossils as the *Illænus Barriensis;* the *Euomphalus*, and other shells at Woolhope, preserved perfectly in the midst of an enormous bed of limestone. And does this hypothesis give any satisfactory account of the nodular masses? Can they be supposed to be formed in the same way as coral reefs?

Altogether, the facts above mentioned seem to me to point to some kind of aggregation of particles, like to like, probably *after* the deposition of these strata. While they were in the transition state between mud and rock, the limestone particles which had been equably distributed throughout them arranged themselves in definite layers to form strata, or round certain centres to form nodules, in a manner analogous to that in which metals crystallize themselves from their vast dispersion throughout the substance of the globe. It is quite true, we know but little of the effects of such forces, exerted incessantly during countless ages, but we have good reason to believe that they have acted; and may we not, with some probability, refer to them such phenomena as I have described?

Let it be remembered, that two distinct facts demand explanation:—1st, the preponderance of lime in certain comparatively thin strata; and, 2ndly, the not less remarkable absence of lime in strata enormously thick. Are not these facts correlative? Is it not probable that the lime which once composed part of the fossils in the earthy strata has been agglomerated in these bands and nodules, by a process on a large scale analogous to that which takes place in the formation of flints, and, in some degree, like the aggregation of the metals?

Dear Sir,—I enclose the above suggestive note by my friend the Rev. J. La Touche, a working geologist, trained in the the Ludlow school.

I cannot say I agree with him in his larger generalization, for there is no doubt whatever of the actual deposit of these beds of limestone, again and again, over the same area, with interruptions marked by the deposit of shale. Nay, strange as it may seem, the beds of limestone, crammed with fossils, often alternate closely with beds of shale, in which one can hardly detect a fragment of a fossil. In these, and in most cases, I believe, a band of limestone means—a period of "rest." The shale beds are signs of a more turbid action of the water.

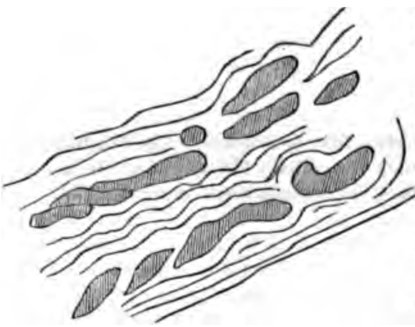


Fig. 1.—Nodules of Limestone in Shale.

But then, his observation is a good one for a great many cases. No one who has studied the old limestones can believe they were deposited quite as we now find them—full of strange lenticular shapes, now crowding out the shale beds, now completely enveloped in them. Such cases as the following are not at all uncommon.

We may be well assured of two things:—1. There *was* a bed of limestone, for the nodules lie in horizontal planes, and are made up of fossils in many cases. 2. The subsequent action has increased the size of the limestone band, and given it a nodular form by attraction round central points.

The old proverb, "He that hath shall have more," is, I believe, strictly applicable in such cases. The band, comparatively rich in lime, has served as a point of attraction for neighbouring small quantities of lime, precisely as my friend suggests. And, really, the analogy with flints, and not remotely so with metals, is much to the point.

I had lately before my eye a thick series of nodular limestones in that little-known formation, the carboniferous slate. A rough drawing of it might be thus given:—

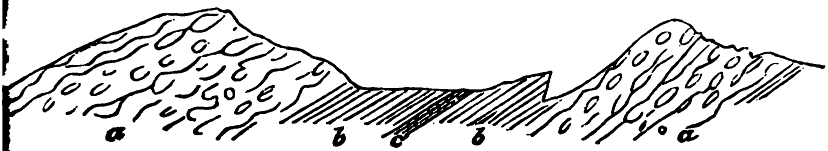


Fig. 2.

Here were thick beds, 28 feet and 25 feet respectively, of nodular limestone among shale, separated by a thick band of shale, *b c*, without limestone, or, rather, with only a uniform distribution in small proportion to the mass; and a flat bed of lime in the middle, *c*.

But the nodules were extremely regular—the projection of one fitting opposite the recess of another, and the shale between following these sinuosities. These could never have been the lines of original deposition. Moreover fossils, though plentiful enough, did not form the mass of the limestones *a*. Here segregation is evident enough.

It is the commonest of all phenomena to meet with beds of lime-stone in which the lenticular form prevails, and to find such beds crowded with fossils. Here we have the result of the two causes—plain deposition and subsequent segregation. The base

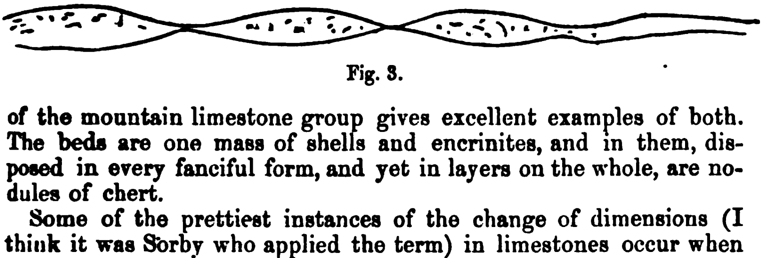


Fig. 3.

of the mountain limestone group gives excellent examples of both. The beds are one mass of shells and encrinites, and in them, disposed in every fanciful form, and yet in layers on the whole, are nodules of chert.

Some of the prettiest instances of the change of dimensions (I think it was Sorby who applied the term) in limestones occur when the rocks containing them are cleaved. In such cases, where cleavage is well-developed, the limestone nodules will often form along the cleavage, *i. e.* the line of least resistance. In cases where great pressure has been exerted, the bed of limestone is often violently crumpled up, while the shale has quietly submitted to be squeezed, and "made no sign," though every layer of it must have undergone the same process. I have, in my sketch-book, a Devonian limestone bed, near Ilfracombe. Here are two lines of original deposit; *a* and *b* were limestone bands, and are full of encrinites, but the thickness of neither *a* nor *b* can be determined except by calculation; the bed is squeezed into nothing in one part, thickened out to thrice its original diameter in another. The mass has changed its dimensions; and a limestone band could not have done this without a rearrangement of its particles. This is, in part, what Mr. Latouche means. However, we must combine the two ideas: original deposit, as bands of limestone, of which we have abundant instances—the whole mountain-limestone to wit—with that of a very frequent, nay, I am inclined to believe, all but universal—alteration, and segregation afterwards. In this way we may account for nearly all the vagaries of limestone—and they are neither few nor small. The arrangement of the shale itself in layers parallel to these concretions, nodules, and irregular layers, is yet more difficult of explanation, Yet it is certain. It is foliation on a small scale. Are the rocks never at rest?

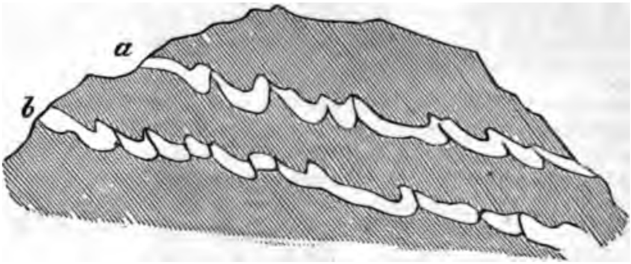


Fig. 4.

J. W. SALTER.

ON THE GEOLOGICAL EVIDENCES OF HORSES IN THE NEW WORLD.

By CHARLES CARTER BLAKE, ESQ.,
Lecturer on Zoology at the London Institution.

Before attempting to deduce any general conclusions respecting the geological evidences of the genus *Equus* in the New World, it is necessary to have clear ideas respecting the geographical distribution of its members. In the first place, therefore, I give a sketch of the classification and range of the existing species.*

* Much information may be derived from the works of Owen, Gervais, Gay, Gray, Hamilton Smith, Crawfurd, Darwin, Leidy, Lubbock, Pictet, Bronn, Falconer, Sclater, Bartlett, Nott, Gliddon, Blyth, Laird, Sykes, Youatt, Schreber, Wagner, and others, and at the end of this series I shall give a list of the authors to which I have referred.

In the geographical distribution of animals into provinces, I follow the philosophical arrangement proposed by Dr. P. L. Sclater, who has applied the classification to ornithological arrangement with so much success.

	Palæarctic.	Ethiopian.	Indian.	Australian.	Nearctic.	Neotropic.
us caballus	+	—	—	—	—	—
s asinus	+	—	—	—	—	—
s onager	+	—	+	—	—	—
s hemionus	+	—	+	—	—	—
us equuleus ?......	—	—	+	—	—	—
us quagga.........	—	+	—	—	—	—
us Burchellii......	—	+	—	—	—	—
us zebra	—	+	—	—	—	—

e following species are of doubtful specific value :—

	Palæarctic.	Ethiopian.	Indian.	Australian	Nearctic.	Neotropic.
us varius	—	—	+	—	—	—
us hippagrus ...	—	+	—	—	—	—
us hamar	+	—	—	—	—	—
us antiquorum ...	—	+	—	—	—	—
us isabellinus? ...	—	—	—	—	—	—

e geographical distribution of fossil horses was as follows :—

	Palæarctic.	Ethiopian.	Indian.	Australian.	Nearctic.	Neotropic.
us fossilis	+	—	—	—	—	—
us plicidens	+	—	—	—	—	—
us piscenensis ...	+	—	—	—	—	—
us palæonus	—	—	+	—	—	—
us sivalensis	—	—	+	—	—	—
us Namadicus ...	—	—	+	—	—	—
us curvidens......	—	—	—	—	—	+
us neogæus	—	—	—	—	—	+
us Chilensis	—	—	—	—	—	+
us nearcticus......	—	—	—	—	+	—
us asinus fossilis		—	—	—	+	—

e geological distribution of fossil horses was—

	Eocene.	Miocene.	Pliocene.
Equus palæonus	—	+	—
Equus sivalensis	—	+	—
Equus Namadicus ...	—	—	—
Equus fossilis	—	—	+
Equus plicidens	—	—	+
Equus piscenensis ...	—	—	+
Equus curvidens	—	—	+
Equus neogæus	—	—	+
Equus Chilensis	—	—	+
Equus nearcticus......	—	—	+
Equus asinus fossilis	—	—	+

Equus fossilis, *V. Meyer*, *Palæologica*, 8*vo*, 1832, *p*. 79. *Owe* *British Fossil Mamm. p*. 383.

The common British fossil horse, evidences of which are so con mon in our bone caves and pliocene deposits, Professor Owen state to have been characterized by a larger head than the domesticate races; resembling, in this respect, the wild horses of Asia describe by Pallas, and in the same degree approximating the Tebrine an Asinine groups. He also points out that the second and third mola of both jaws are narrower transversely in comparison with thei anteroposterior diameter than in the existing horse; a characte which, although present in the teeth derived from the Kirkdale Cav Oreston, and the newer pliocene blue clay at Cromer, was absent i some of the Kent's Hole specimens. With respect to the mor important characters of the degree and mode of plication of th enamel folds, no specific differences are demonstrated by Professo Owen between the *E. fossilis* and the *E. caballus*. The range c variation, however, amongst the existing horses, is as yet undete mined; and I purpose, at a future time, to institute an accurate com parison, which would be, however, beyond the scope of the presen paper. In Norway, I am told, on the authority of Mr. A. I Bartlett, F.Z.S., that there still exists a breed of horses with traces c the zebra-striping on the legs. It would be a most fruitful source c information if the teeth of these horses were to be compared wit those of the fossil European species; and I doubt not but that th perseverance of the Superintendent of the Zoological Gardens wil be crowned with success, in obtaining living specimens of this breed

Colonel Hamilton Smith divides the species *E. caballus*, or tru horse, into four distinct origins: (a) the bay wild horse, or Tarpan (b) the white villous wild horse; (c) the black wild horse; (d) th Eelback, dun decussated.

Characters.—Hitherto undetermined.

Geog. Distrib. Northern Europe.—*Geol. Age.* Pliocene.

Equus plicidens, *Owen*, *Brit. Foss. Mamm.* 392; *Report Brit Ass.* 231. (First upper molar, second upper molar, right lower canin (juv.) astragalus, hoof phalanx.)

Characters.—Enamel more complex than in *E caballus;* crown of last upper mola bilobed posteriorly, as in *Hipparion*, from which it differs in the form of the fifth or in ternal prism of dentine in the upper molars, and in its continuation with the anterio lobe of the tooth; differing, like *E. fossilis*, from *E. caballus*, in greater anteroposterio diameter of crown of second upper molar, and less produced anterior angle of first molar (Owen.)

Geog. Distrib. Oreston cave.—*Geol. Age.* Pliocene.

Professor Owen says on this, "One cannot view the elegant fold ings of the enamel in the present fossil teeth, and in those of th more ancient primigenial species (*Hippotheria*) of the Continenta Miocene deposits, without being reminded of the peculiar characte of the enamel of the molar teeth of the *Elasmotherium*, in which it i folded in elegant festoons." It is indeed a singular fact, althoug one accountable on a known biological law, that the more ancien species of *Hipparion* and *Equus* should exhibit the more generalized type of perissodactyle dentition.

EQUUS PISCENENSIS, *Gervais, Zool. and Paléontol. Françaises, p.* 67, *pl.* 21, *figs.* 9, 10. (Upper portion of the cannon bone of the forefoot; first phalanx.) This species, smaller than the horse, has been founded by M. Gervais on the above bones of the extremities. The teeth are wholly unknown.

Geog. Distrib. Right bank of the Riége, near Pézenas (Herault). —*Geol. Age.* Pliocene.

EQUUS PALÆONUS, EQUUS SIVALENSIS, EQUUS NAMADICUS.—These three species are figured in *Falconer and Cautley's* '*Fauna Antiqua Sivalensis,*' but no description is there given. The figured specimens are in the British Museum.

EQUUS CURVIDENS, *Owen in 'Fossil Mammalia of the Voyage of the Beagle,' p.* 108, *pl.* 32, *figs.* 13, 14.

Characters.—Molar teeth left side upper jaw, slightly smaller and more curved than *E. caballus*. A superior molar of the right side was derived from Bahia Blanca, but its friable condition precluded its representation in Professor Owen's work.

Geog. Distrib. Punta Alta (Bahia Blanca), Santa Fé in Entre Rios. —*Geol. Age.* Pliocene.

EQUUS NEOGÆUS, *Lund.*—*Syn.* Equus macrognathus (*Weddell, p.* 204). E. principalis, *Lund, Ann. des Sci. Nat.* xii. *p.* 309. Equus Devillei, *Gerv.*

Mr. Lund, the founder of the species, characterizes it by the greater breadth and flatness of the metatarse than any existing horse. The name *macrognathus* is founded on the greater length of the *diastema* in the Tarija specimens. The two lobes of the lower molars are more distinctly separated than in the *E. caballus*, although there is no interruption in the ribbon of enamel.

Castlenau calls attention to their more generalized type in the following words:—"Before the crowns are worn, the thickness of the cement gives them a rather peculiar appearance, which makes them, up to a certain point, resemble those of *Rhinoceros*, because the arched form of each of their lobes is then more apparent, and because the ends of each curve are prominent in a tubercular form."

Equus Devillii is not characterized by Lund, but Gervais figures a fragment of lower jaw, and an astragalus, the proportions of which are different from those of *E. neogæus*. The differences in the molar teeth are however very slight.

Geog. Distrib. Tarija (Bolivia, Brazil).—*Geol. Age.* Pliocene.

EQUUS CHILENSIS.—*Syn.* Equus Americanus (*Gay*, i. 146). (Third lower molar, left side.)

Characters.—Molars as large as those of *Equus caballus*, and perhaps a little thicker: having the same general arrangement of enamel, dentine, and cement as it, but differing in some minor modifications. Thus, the conformation of the curves (*las redondeces colocadas*) attached to the inner border of the crown is somewhat more broad, and the space in the little isthmus which joins the first and second of these inner curves to the two oval ones outside, is also more broad and with plications less crenulated (*frisado*). (Gay, *loc. cit.*)

Geog. Distrib. Taguatagua lagoon (*Gay*).—*Geol. Age.* Pliocene.

EQUUS NEARCTICUS.—*Syn.* Equus Americanus (*Leides*).

Characters?—I am yet unable to form any distinct idea as to this species from tl few figures and descriptions I have seen. The name *Americanus* is, however, glaring inappropriate; as also, in a less degree, are those of *E. neogæus* (which should be *ne tropicus*), and *Chilensis* (a name which the discovery of the species elsewhere wou nullify). Names like *curvidens*, *plicidens*, *macrognathus*, are much more convenient, they give a more or less distinct idea of the characters of the fossil.

Geog. Distrib. Confederate and Federal States.—*Geol. Age.* Pli cene.

The problem which we have to solve is, whether the *E. Chilensi neogæus*, and *curvidens* are distinct species. Gervais, in Castelnau work (page 33), assigns them all to one species, of which he retair the name *E. neogæus*. He however separates *E. Devillii* with a expression of doubt, saying that "slight differences in the form lower molars, and a smaller size than that of *Equus neogæus*, ar the only characters which we can yet assign to it. Its smalle size seems to exclude the possibility of its similitude with *E. princ palis*, of which the undiagnosticated name appears to indicate a cer tain superiority in relation to the other animals of the same genus. The fragment of lower jaw belonging to *E. Devillii* bore the si principal molars. These teeth are small, with less coronal complexit and remarkable for a little different disposition of the *boucles intern* which the enamel forms inside each lobe. The total length of the si molars is only 0·160, instead of 0·195; the first tooth, separatel measures 0·030, instead of 0·035, in the *E. neogæus*; the fourth, 0·02 and the sixth, 0·030. I cannot coincide with M. Gervais in con sidering these differences specific.

The question, whether *Chilensis* and *neogæus* are identical, nex comes before one. In order that my readers will appreciate the diffi culty, I figure 76 from Gay's 8th plate, and 4 *a* from Castelnau's 7t plate. The first is *E. Chilensis*, the second *E. neogæus*.

E. curvidens (Owen) I am unable specifically to distinguish fro *E. neogæus*. I figure the corresponding teeth.

The object of this brief note is merely to point out that the tim is not yet arrived when any general proposition can be laid dow respecting the geographical distribution of horses in the New World As regards their geological age, they are all from later tertiary, pro bably pliocene or pleistocene deposits. None of the South America species offer any points of resemblance to the genus *Hipparion*, o three-toed horse of the Old World. No species of *Hipparion* has ye been discovered in America.

EXPLANATION OF THE PLATES.

Pl. II. Fig. 3, *Equus macrognathus*; fig. 4, *Equus Devillii*.

Pl. III. Fig. 1, *Equus Chilensis*; fig. 2, *Equus macrognathus*; fig. 3, *Equus macro cephalus*.

ANALYSIS OF THE RED CHALK OF HUNSTANTON, ON THE COAST OF NORFOLK.

By R. Calvert Clapham, Esq.

During one of the excursions of the late meeting of the British Association at Cambridge, the red chalk of Hunstanton was examined, and as I am not aware of its having been previously analysed, I obtained a specimen to analyse.

The bed of red chalk is about 3½ feet thick, and runs along the coast, distinctly seen for some miles. It rests immediately upon the Greensand, and above lies a bed of white chalk, varying in thickness from 25 feet downwards.

Professor Phillips, of Oxford, informs me that this bed of red chalk has been traced from Speeton, in Yorkshire, to Spilsby, in Lincolnshire, and reappears at Hunstanton, in Norfolk.

It contains many fossils, chiefly of the White Chalk, and also fossils of the Greensand and Gault.

It is an interesting question to consider what is the cause of colour in the red chalk. Professor Phillips thinks that it is derived from decomposed glauconite or decomposed augite (both of which contain protoxide of iron and magnesia). It may also be caused by decomposed iron pyrites, as it will be observed it contains a trace of sulphate of lime.

At Speeton it is in some places a soft red clay, and is used to colour bricks and rough pottery.

The following is the analysis:—

	Red chalk.	White chalk.
Carbonate of lime	80·04	95·80
Sulphate of lime	0·10	trace only.
Peroxide of iron	9·60	1·08
Alumina	1·42	0·52
Magnesia	nil.	0·48
Silica	9·28	2·28
Manganese	trace.	0·11
	100·44	100·27

Walker, Newcastle-on-Tyne, November, 1862.

CORRESPONDENCE.

Ages of Mineral Veins.

Sir,—Upon reading your report upon Mr. Moore's paper on the "Palæontology of Mineral Veins, etc.," before the British Association, a circumstance bearing upon the question occurred to my recollection, which I would have mentioned had I been present in the Section at the time the paper was brought forward. Mr. Moore shows that lead veins in the

Mendip district and elsewhere reveal contents of Secondary age. I noticed many years ago, when the railway was being made from Frome to Radstock, that lead ore had been present in the inferior Oolite, where it reposes immediately upon the Carboniferous Limestone, at a spot near the letter "k" in the word "Pike" on the Ordnance map, about a mile (to scale) north of Frome. If my memory serves me, the ore occurred in veins in joints in the Oolite. This proves that, even if the lead veins of that district are not wholly of Secondary age, at any rate the deposit of ore was not *concluded* until after the deposition and solidification of the inferior Oolite. I am, Sir, faithfully yours,

O. Fisher, F.G.S.

Elmstead, Colchester, Nov. 10.

Druid Sandstone.

Dear Sir,—In your last number of the 'Geologist,' page 450, Mr. Bensted makes the remark, that the statement of Dr. Mantell still holds good, that no regular stratum of the Druid Sandstone has yet been discovered in this country; and its geological position is still undetermined.

The following observations will, I believe, throw some light upon this question. Close to the village of Broodmayne, about five miles from Dorchester, on the Wareham road, are several blocks of Druid Sandstone, in two fields on each side of the road, close to a farmhouse, marked "Little Mayne" on the map. These blocks have been a puzzle to the local archæologists, who have endeavoured to give them an antiquarian value, and to explain their arrangement as belonging to some ancient so-called "Druidical" work. They are however a natural deposit, and as I conceive, are, so to speak, *in situ;* that is to say, they have not travelled any distance from the place where they were formed. The locality is on the line of junction with the Chalk of a small outlier of the Lower Tertiaries. These beds are extremely variable in character, and at this spot a fine sharp white sand crops out on the north side of the shallow valley in which the blocks lie. In the side of the road this sand has been cut into, and two of the blocks of sandstone are seen, one partly cropping out on the surface, with its lower portion embedded in its native sand. The other is entirely enveloped in the sand, except as far as it has been exposed in cutting the road.

The blocks are evidently indurated masses, or septaria of this bed of sand.

The denuding forces which have scooped out the valley, have removed* the sand and left the blocks behind.

There are numerous other blocks of a similar character on and beneath the lofty hill called Blackdown, near Portisham. These however are conglomerates of large flints. Some lie on the top of the hill on the upper surface of the chalk, almost *in situ*, as at Mayne, and close to the Tertiary beds from which they came; others have been carried by some torrential action into the deep valleys of Portisham and Bridehead beneath.

I remain, faithfully yours,

O. Fisher.

Elmstead, Colchester, Dec. 10.

Restoration of Pteraspis.

MY DEAR SIR,—Mr. Lankester, in referring in your last number to a paper of mine, in your November number, has given us two sketches of specimens of Pteraspis and the restoration of the test by Professor Huxley. Substantially, in the diagram of Professor Huxley, and in my second figure, we have the same elements; and with my other figures Mr. Lankester does not interfere. I do not think, however, that his specimens are so decisive as he implies they are. In his first sketch there is no decided appearance of the central ridge or prolongation, and it appears to me, that there is a much larger portion of the test posterior to the cornua than what is to be discovered in the restoration of Professor Huxley. In his second sketch or specimen, I cannot see any certain evidence of the cornua at all, and therefore, from it also, I cannot gather how the spine or central prolongation of the shield is related to them. Mr. Lankester informs your readers of first-rate specimens having been in the museums and in private collections for some years. Perhaps some of these may throw light on this point, and on other points connected with Pteraspis.

Meantime, believe me, my dear Sir,

Yours truly,

Craig, Dec. 8. HUGH MITCHELL.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

GEOLOGICAL SOCIETY.—*November* 19*th.*—" On the Cambrian and Huronian Formations, with remarks on the Laurentian." By J. J. Bigsby, M.D. The author came to the conclusion that the Cambrian and the Huronian are distinct formations, and the latter is very much the older.

December 3*rd*, 1862.—1. " Description of the Remains of a new Enaliosaurian (*Eosaurus Acadianus*), from the Coal Formation of Nova Scotia." By O. C. Marsh, Esq., M.A. Communicated by Sir C. Lyell, V.P.G.S.

2. " Description of Anthracosaurus, a new genus of Carboniferous Labyrinthodonts." By Professor T. H. Huxley, F.R.S., F.G.S.

Anthracosaurus is distinguished from all other known Labyrinthodonts by the quadrate form and oblique position of the orbits, by the existence of elongated supratemporal foramina, and by the comparatively small number and large size of the teeth. The skull exhibited had an extreme length of 15 inches, and an extreme width of 12 inches. There are about 30 maxillary, 2 vomerine, and 10 palatine teeth, which are ridged, and become flattened and two-edged towards their apices. The vomerine, palatine, and some of the anterior maxillary teeth are between 2 and 3 inches long, and from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in diameter at the base. The species exhibited was named *A. Russelli*, after its discoverer. Probably its entire skeleton had a length of not less than 6 feet.

3. " On the thickness of the Pampean Formation near Buenos Ayres." By Charles Darwin, Esq., M.A., F.R.S., F.G.S.

Some sections of Artesian wells sunk in this formation showed its entire thickness near Buenos Ayres to be about 210 feet. It was stated to rest upon various marine beds upwards of 100 feet thick, containing *Ostrea Patagonica*, *Ostrea Alvarezii*, *Pecten Paranensis*, etc. These reposed upon red calcareous clay, which was bored through to a depth of 213 feet more, contained no fossils, and is of unknown age.

4. "Geological Notes on the Locality in Siberia where Fossil Fishes and Estheriæ were found by Dr. Middendorf." By C. E. Austin, Esq., C.E., F.G.S.

5. "Note on *Estheria Middendorfii*." By Professor T. Rupert Jones, F.G.S.

Two ancient stone axes from Trinidad, and one from Santa Cruz, were exhibited by J. Lamont, Esq., F.G.S.

December 17*th*.—1. "On the Skiddaw Slate Series." By Professor R. Harkness; with a note on the Graptolites, by Mr. J. W. Salter. Some general sections through the Skiddaw Slates were described in detail, and the localities in which fossils had been previously found by Professor Sedgwick were especially noticed. The author stated that he had discovered several species of Graptolites new to the Skiddaw Slates in certain flaggy beds almost devoid of cleavage, which occur at intervals in the lower portion of the series, in several localities. Professor Harkness showed that these rocks were much more fossiliferous than had hitherto been supposed; and that the evidence of the fossils, as interpreted by Mr. Salter, clearly proved them to be of the same age as the Lower Llandeilo rocks of Wales and the Quebec Group of Canada. The thickness of the Skiddaw Slates was estimated at 7000 feet, and the total thickness from the base of the Skiddaw Slates to the Coniston limestone at 14,000 feet. Besides several species of well-known Graptolites that are also found in the Lower Llandeilo rocks and in the Quebec Group (Taconic System), Mr. Salter has been enabled to identify *Phyllograpsus angustifolium*, Hall, *Tetragrapsus bryonoides*, Hall, and another species of that genus, *Dichograpsus Sedgwicki*, n. sp., *Didymograpsus caduceus*, and some others. He has given the name of *Caryocaris Wrightii* to a Crustacean discovered in these rocks by Mr. Wright. Mr. Salter considers the Skiddaw Slates to be of the same age as the Quebec Group, the graptolitiferous rocks of Melbourne, and the Tremadoc Slates of Wales.

2. "On Fossil *Estheriæ*, and their Distribution." By Professor T. Rupert Jones. The author pointed out the chief characters of the fourteen species of *Estheriæ* obtained, from several geological formations; and stated that they belong mainly to the passage-beds, and he believed chiefly to fresh and brackish waters. He also compared the distribution of the twenty-two recent species with that of the fossil *Estheriæ*.

3. "On the Flora of the Devonian Period in North-Eastern America." By Dr. J. W. Dawson. Dr. Dawson enumerated in this Appendix some additional species of plants lately obtained from Perry, by Mr. Brown, of that place. He also stated that recent observations have shown that the beds spoken of in his paper as belonging to the Cattskill Group of New York, really represent the Chemung Group of that State, according to Professor J. Hall.

Royal Society.—*November* 20*th*.—One of the largest meetings of the Royal Society we remember to have seen. The attraction was Professor Owen's paper on the remarkable fossil feathered animal which has lately been added to the national collection—the *Archæopteryx macrurus*. In his opening remarks Professor Owen detailed the circumstances attending the discovery of the first evidence of the class Birds in the Oxfordian strata, being the impression of a feather, which was described by Hermann von Meyer, who established for it the genus *Archæopteryx*. This name was retained for the present feathered animal. On November 9, 1861, Andreas Wagner communicated to the Mathematical and Physical Academy of Munich the account of the discovery of an animal with divergent fans of feathers, with which he had become acquainted, on the authority of

I. Witte. Wagner termed this animal Griphosaurus, and, unfortunately, oon after died. Professor Owen communicated with the owner, M. Häerlein, of Pappenheim, whose collection Mr. Waterhouse was deputed to nspect, and ultimately to purchase. The ventral aspect of the specimen ras exposed, the furculum marking the fore part of the trunk. It was . foot 8½ inches in length, and measured across, from the apex of the right o the left wing, 1 foot 4 inches. Near the anterior border of the impressions of the wings the stone was broken. The head may have been within his broken part. The ischium, showing the acetabulum, twenty caudal rertebræ, several ribs, the left scapula, proximal part of the left humerus, listal part of ditto, left radius, ulna, and carpals, right humerus, radius, ind ulna, two right metacarpals, and two ungual phalanges, right femur, right tibia, left femur, left tibia, were preserved, as well as impressions of the quill feathers, and of down on the body; one clawbone belonging to the right digit of the wing was present, of which bone counterpart impressions exist. The vanes, and even the shafts of the feathers, can be distinctly seen by the naked eye. The furculum, pelvis, and bones of the tail are in their natural positions. The left scapula is displaced backwards: the left humerus outwards and a little forwards, as well as the antibrachium. The wing feathers diverge one inch in front of the carpus. The right humerus extends backwards, and the two metacarpals or proximal phalangeals are dislocated inwards. Fourteen long quill-feathers diverge on each side of the metacarpal and phalangeal bones; the tibia extends outwards. The foot is contracted; the left femur is turned outwards. The feathers decrease in length from six inches to one inch; the anterior series of barbs are longest and obtusely rounded. The area covered by the diverging quills of the left wing is 14 inches; by the right, 11. The three posterior primaries are dislocated backwards; one primary is exquisitely preserved. The impressions of tail feathers number twenty, and succeed each other; the principal correspond in number on each side with the tail vertebræ. The length of the anterior tail feathers is 1 inch, at the end 5 inches; the tail is 11 inches in length, and 3½ in breadth, being obtusely truncated at the end. The wings have a general resemblance to those of the gallinaceous, or round-winged birds. The scapula resembles that of a bird, and was compared with a structure in *Pterodactylus Suevicus*, which was about the same size as Archæopteryx. The curved clavicle was 2 inches long. The scapula was 2 inches broad at the apex, the arch being open and round, not contracted as in Gallinaceæ. No Pterodactyle had a furculum. The humerus, 2 inches 10 lines in length, is sigmoidally flexed as in birds; it was 6 lines in breadth, and in contour most like that of the Corvidæ. The humerus of the Archæopteryx closely resembles the form in many birds, as the penguin, the touraco, etc. The Pterodactyle's radius and ulna were equal in thickness; not so in Archæopteryx. A single carpal bone is shown on the left side; on the right a mass of spar occupies its place; but it is a doubtful indication. The form of the metacarpals agrees with those of birds; but if they be proximal phalanges they differ, being more equal in length and thickness. There is the impression of a slender bone 11 lines long, like the basal part of an ungual phalanx: in advance, a bone supporting the penultimate phalanx is seen in both slabs, being in appearance like the claw phalanx of raptorial birds. The hand, besides supporting the remiges of the wing, probably supported a digit with a small though pointed claw. The structure of the hand otherwise agreed with birds, and similar claws or spurs exist in the *Parra jacana*, the *Palamedea*, the spur-winged goose, and the Syrian blackbird. The Archæopteryx differs from all known birds in having two or three digits in the hand. There was no trace of the fifth digit of the winged reptile. Of the pelvis, a bone on the left side was preserved, bearing a resemblance to the iliac bone of a bird, and with a sinuous border; its exposed surface was smooth and polished, and 7 lines broad. The antero-interior surface of the ilium and the coalesced ischium terminate abruptly and obtusely, as in a young bird. The ischium, behind the acetabulum, shows a vacuity between itself and the pubis, the obturator foramen being as large as in birds. In the Pterodactyle the ilium is shorter, the ischium being subtriangular, joining with the ilium. The sacrum was a confused mass of vertebræ, in which six or seven short transverse processes can be seen. The conditions under which the skeleton was found reminded Professor Owen of the carcass of a gull, which, after having been a prey to some carnivore, which had removed all the soft parts, and perhaps the head, had left nothing but the bony legs, and the indigestible quill-feathers. The tarso-metatarsal, at its distal end, exhibited a trifid, trochlear, articular surface, supporting three toes. The shaft of the femur was long and thin, while a procnemial ridge was present on the tibia. The size of the procnemial ridge is variable in birds; in Archæopteryx it was as large as in *Falco trivirgatus* and in most Volitores. The thigh was longer than in the majority of birds. The proportions of the toes accord with the insessorial, and not with the scansorial type of foot. Few of the bones are in a condition to permit minute comparison of their texture. The osseous remains having been exposed to a disintegrating action by which the phosphate had been converted into carbonate of lime, and in the interior of the bones crystallized spar has been deposited. Each vertebra of the tail supports a pair of plumes. The fossil differed from all known existing birds in having a tail composed of twenty vertebræ. But the tail is essentially a variable character; there are long-tailed bats and short-tailed bats, long-tailed rodents and short-tailed rodents, long-tailed Pterodactyles and short-tailed Pterodactyles. It is now manifest that there existed, at the period of the deposition of the Oxfordian strata, a bird exhibiting the persistent embryonal or generalized character of the tail, as opposed to the specialized condition of the tails of existing birds, in which the terminal vertebræ have coalesced. All embryo birds exhibit the caudals distinct, the greatest number of separate caudals being exemplified by the ostrich. The developmental process undergone by the bird is similar in nature to that through which the fish passes in its transition from the heterocercal stage, through which it usually passes, to the homocercal. The probability of the presence of a single unguiculate digit, as in the wings of Pteropus, would, if demonstrated, exhibit a similar retention of an embryonal and transitory character. The Archæopteryx was unequivocally a bird; and, by the law of correlation, we might infer that it was destitute of fleshy lips, that its feathers were preened by a horny edentulous beak, and that the shape of the breast-bone was such as was possessed by animals capable of flight. The President moved a vote of thanks; and, calling for remarks, the Duke of Argyll hoped that Mr. Gould would offer some opinion on the fossil. Mr. Gould, F.R.S., considered that the remains indicated a terrestrial form of bird, with wing feathers not adapted for flight, as in the Apteryx, or in the black rail of New Zealand. Had the hind foot alone been shown to any ornithologist, he would have been entitled to infer that it was a bird—a fact which Mr. Gould had doubted up to the previous day, but which he now felt constrained to admit. Dr. Carpenter, F.R.S., coincided in Professor Owen's remarks respecting the more generalized vertebrate type of the specimen, and remarked on the futility of negative evidence in geological discussion. Professor Owen pointed out that the shape of the pecral ridge on the humerus indicated a bird which possessed the power to ›at its wings down forcibly, and that the shape of the furculum also in- icated a bird of flight. The black rail had no furculum. Mr. Gould ad- ›red to his previous opinion.

MANCHESTER PHILOSOPHICAL SOCIETY.—*Dec. 2nd.*—E. W. Binney, .R.S., the President, said that in a paper published in vol. x. (second ›ries) of the Society's Memoirs, "On the Drift Deposits found near lackpool," he had stated, in a note at page 122, that since the paper was ritten, Mr. J. F. Bateman, C.E., F.G.S., had informed him that in aking the Hollingworth reservoir, near Mottram-in-Longdendale, he had et with the common cockspur shell (*Turritella terebra*) in considerable bundance. During the past summer he had visited the locality alluded o by Mr. Bateman, in company with Mr. Prestwich, F.R.S. After going p to the uppermost part of the reservoir, which is one of those belonging o the corporation of the City of Manchester, to the point where the goit onveys the water on the east side of the valley, we saw a deposit of brown andy clay, or till, which had been cut through to the depth of between hree and four feet for the purpose of forming the goit. This deposit con- ained small granite and greenstone pebbles, some rounded, and others ngular. In it he found a considerable number of shells, some quite entire and others in fragments. He procured and showed to the meeting specimens of *Turritella terebra*, *Fusus Bamfius*, *Purpura lapillus*, two specimens of *Tellina*, and *Cardium edule*. The city engineer, Mr. J. G. Lynde, F.G.S., had given him the exact height of the spot where the fossils were found at as 568 feet above the level of the Irish Sea.

Shells, identical with recent sea-shells, have been found at much greater elevations on the mountains of North Wales, but very few so far inland; for the locality where the specimens were met with is full fifty miles in a straight line from the Irish Sea, and a greater distance if the watercourses of the Etherow and Mersey are followed. Mr. John Taylor has found recent marine shells in the sands at Bredbury and Hyde, which he has described in the Transactions of the Manchester Geological Society; and Mr. Prestwich informed him that he has found similar fossils on the Buxton Road, about three miles from Macclesfield, but the specimens herein described are the first that have been noticed in the deep valleys running up into the sides of the Pennine chain.

He further stated that he had found a large mass of greenstone, evi- dently a travelled rock of the Drift period, at the extreme end of one of the tributary valleys of the Tame, in Saddleworth, as high up as New Year's Bridge, near Denshaw Vale. All these facts proved the former presence of the sea (in some cases containing inhabitants similar to those found on our present coasts) high up on the sides of the Cheshire, York- shire, and Derbyshire hills at a recent period, geologically speaking, and show that many of our deep valleys have not been formed by the streams of water now traversing them, but are chiefly due to the more powerful action of the waters of the ocean, most probably assisted by ice.

NOTES AND QUERIES.

OBITUARY.—On the 19th of December, one of the oldest and the most .mous anatomists and ethnologists of Engla.d departed this life. We lu.le to the venerable Dr. Robert Knox, Hon. F.E.S., the friend of Cuvier and Geoffroy St. Hilaire, and the Honorary Curator of the Museum of the Ethnological Society of London. Our space will not permit us to do more than record the fact, with the tribute of our admiration for the talents and labours of the deceased, and the expression of our consciousness that a school of scientific thought was founded by him which will survive when his faults and failings shall have been all forgotten.

Deep Gold Diggings of Melbourne.—As the opinions expressed by Sir Roderick Murchison ('Siluria,' 3rd edit. p. 488), that wherever the veinstones in the solid rock have not been ground down by denudation, and remain as testimonials of the original seat of the gold, the portions which have as yet proved to be the richest are those which are at or nearest the surface, have been recently seemingly impugned by the accounts which have reached us respecting the deep quartz gold mines in Australia,—the following note, by Professor M'Coy, of Melbourne, gives an important confirmation of the correctness of Sir Roderick's original conclusion. In a private letter, writing of the deep gold diggings of Melbourne, he makes these comments on them:—"Sir R. Murchison's theory, which I have always upheld, of the ratio of gold in the quartz veins diminishing with the depth, is every day getting more support. You must be cautioned that so many ounces of gold, said to have been crushed from so many tons of quartz from deep mines, really means, that perhaps 1000 tons may have been mined, and out of it 100 tons picked as rich enough to be sent to the mills; so that the richness of the deep quartz is very different from what it would appear without this correction, which you must always ask after before you give up your correct position, yielding to the logic of supposed facts which are really capable of explanation."

Canadian Petroleum.—The 'Canadian Journal of Art' asserts that the Canadian petroleum is not derived from coal, nor is it of recent origin. It says: "Petroleum was formed long before the coal, and is the result of an infinite number of oil-yielding animals which swarmed in the seas of the Devonian period long anterior to the coal. The decomposition of marine plants may have given some oil to the rocks of Canada and the United States which are saturated with this curious substance. The shale beds of Collingwood furnish an answer to those who object to the infinite number of animals it would require to produce the oil locked up in the earth. These shale beds are composed altogether of the remains of trilobites; they extend from Lake Huron to Lake Ontario, and from west and east of these lakes. The oil-bearing rocks of Canada were once a vast coral reef, extending from the Gulf of Mexico to Lake Superior."

Iron Formed by Animalcules.—In the 'Journal de l'Instruction Publique,' M. Oscar de Watterville states that in the lakes of Sweden there are vast layers or banks of iron exclusively built up by animalcules. The iron thus found is called "lake ore," and is distinguished according to its form, into "gunpowder," "pearl," "money," or "cake" ore. These iron banks are often from 10 to 200 yards in length, 5 to 10 broad, and from 9 inches to a yard in thickness. In winter, the Swedish peasant, who has but little to do in that season, makes a hole in the ice of a lake, and with a long pole probes the bottom until he has found an iron bank; an iron sieve is then let down, and with a sort of ladle conveniently fashioned for the purpose, the loose ore is shovelled into the sieve, which is then hoisted up again. The ore thus extracted is of course mixed up with sand and other extraneous matters, which is got rid of by washing in a cradle like that used by gold diggers. A man can turn out a ton of ore per day by this process."

REVIEWS.

Carte Agronomique des Environs de Paris. By M. Delesse.

A "Carte Agronomique des Environs de Paris" has been published by M. Delesse. We need not say that a map by the able engineer of mines and professor of geology at the Ecole Normale is a good one. M. Delesse is one of those men who never do anything otherwise than well. Although the vegetable soil is only of slight thickness its importance is very great, and many *savants*, at the head of whom is M. De Caumont, have attempted to represent its variable composition by special maps called "Cartes Agronomiques." M. Delesse has lately laid before the French Society of Agriculture one of these maps for the environs of Paris. Such labours are not without considerable difficulties in their execution. The soils require detailed and minute examinations, and their characters sometimes change completely in contiguous districts; on the other hand, the elements remain nearly always the same, and vary more in their proportions than in their nature. This uniformity of materials causes the greatest difficulty in denoting the mineralogical composition, changing sometimes in an insensible and gradual manner; and thus, whilst, on the one hand, the different vegetable soils are not separated by exact limits, on the other, the mineralogical composition is very complex. It is hence scarcely possible to figure them by tints, as one would do a geological rock. The notation adopted by M. Delesse is in this manner:—The soil richest in humus is indicated by fine blue diagonal hatching; the sand, gravel, and stony débris forming the residue of lævigation, by red parallel signs; and the clay, marl, humus, and particles strained off in lævigation, by vertical blue signs, and so on. To render sensible to the eye the proportions of the principal substances over the extent of the maps, these signs have been disposed methodically in small squares.

The details given by M. Delesse on the conditions and manner of occurrence, and quantities in different places, are highly instructive. The soils he finds always contain clay, sand, and ordinarily stony débris. The humus is also found in a constant manner, and is essentially characteristic of a vegetable soil. It is especially very abundant in valleys and in all depressions of the soil, even when these cavities are seated on tops and sides of hills. Particularly it is concentrated in the bottom of damp valleys, and where the soil is saturated with water.

Limestone is found in variable proportions, but its disposition is subject to definite laws. It is wanting generally on the heights. It is wanting also in the soils on the terraces bordering the Seine and the Marne. It is absent even at the head of the valley of the Bièvre. The calcareous region includes the thalwegs, the depressions on the plateaux, the flanks of the hills, and particularly the bottom of the valleys.

The proportion of carbonic acid in the vegetable soil is, on the plateaux, *nil*, or reduced to mere traces. It is only when a very thick diluvial deposit reposes on a calcareous subsoil that it can attain to a few hundredths. On descending a hillside, the carbonic acid is very scanty at the upper part, but augments progressively with the declivity, offering at times various alternations. The same occurs in descending a valley; in that of the Bièvre, for example, carbonic acid is wanting in all the elevated portion; it then augments as the valley descends until it finally attains 10 per cent. On the shores of the Seine and the Marne, it sometimes exceeds 25 per cent. The residue of lævigation is essentially formed of sands coming from the Fontainebleau beds, from flint, gravel, and the limestones of the Beauce and the Brie. Calcareous débris is rare; and grains of iron and feldspar still more so. On the plateaux the residue of lævigation is very variable, even in the vegetable soil covering the same rocks. Thus on the plateaux above Gurches and Meudon, it rises to 70 per cent.; but more to the south, towards Saclay, it is reduced to a few hundredths. In the valleys, also, it varies, not only in the different valleys but also in the longitudinal and in transverse directions. The proportion of fine sand is also very notable in the bottom of the valleys; on the banks of the Seine and the Marne it varies from a few hundredths. Clay is found also in all the soils round Paris, sometimes pure, sometimes in the state of marl associated with lime. The soils which cover the plateaux formed by the lacustrine rock of the Beauce and the Brie, are particularly rich in clay. At Crenilly and Villejuif the proportion of clay is above 50, and it may sometimes reach to 90 per cent. But the clay is especially concentrated in the bottoms of the valleys, whether they be dry or wet.

The examination of the constituent mineral substances shows that the soil comes in part from the subjacent rocks, and partly from the rocks in the neighbourhood; and that it must not be always regarded as a disaggregation *in situ*, for we often find that in limestone rock the vegetable soil contains not a trace of calcareous matter; and, *vice versâ*, a highly calcareous soil over a clay base. The vegetable soil M. Delesse considers as decidedly belonging to the "terrain de transport," or drift, as shown by the sand, gravel, and innumerable rolled fragments it contains.

The practical value of M. Delesse's map is that, in indicating the mineralogical composition of the soil in the Paris district, it is easy to see what lands should be marled, and which should be drained, and to what extent, and with what materials, manures and extraneous substances should be economically employed in agricultural operations.

Ueber Thierfährter und Crustaceenreste in der unteren Dyas, oder dem unteren Rothliegenden, der Gegend von Hohen Elbe. Von Dr. H. B. Geinitz.

On Animal Tracks and Crustacean Remains in the Lower Dyas, or in the Lower Permian Sandstones of the Strata of the Higher Elbe. By Dr. H. B. Geinitz. (Extracted from the 'Isis' of Dresden.) 1862.

Dr. Geinitz, undismayed by the severe criticism he received at the hands of Sir Roderick Murchison, ('Geologist,' January, 1861,) proceeds systematically to describe the fossils which are found in his so-called Dyas strata of Central Germany. Mrs. Josephine Kablik, a lady who cultivates natural science in that neighbourhood, has discovered several interesting fossils, which are described and figured in the work before us.

The *Dalmanites (?) Kablikæ*, Geinitz, is figured. It is a small Trilobite, which Geinitz considers may belong to the Silurian genus Dalmanites. Dr. Geinitz also figures a remarkable Phyllopod crustacean, somewhat resembling the *Branchipus stagnalis* of Linnæus, which he considers to be a new genus, Kablikia. The *Kablikia Dyadica*, Geinitz, is found in the coal-slates of the Lower Dyas, near Nieder-Stepanitz, on the Higher Elbe. The original specimen is in the Dresden Museum.

The limestone slates of the Lower Dyas have afforded evidence of impressions, considered by Dr. Geinitz to be those of a Crustacean, the specimens of which are also in the Dresden Museum. They are somewhat similar to those which Hall has figured in the 'Palæontology of New York,' considering it doubtful whether they belonged to Crustacea or Fishes.

The paper is illustrated with two well-executed lithographic plates.

Observations on the Terms "Permeen," "Permian," and "Dyas." By Jules Marcou. Boston. 1862.

These "Observations" have been reprinted by M. Jules Marcou, from the Proceedings of the Boston Society of Natural History, in which he refers directly to the article by Sir Roderick Murchison, printed in the last year's January number of this magazine, and gives a list of dates in respect to the priority of the term "Permian."

M. Marcou also refers to his own memoir, "Dyas and Trias," in the 'Archives de la Bibliothèque Universelle de Genève,' 1859, as treating the two questions entirely distinct. Since the first publication of M. Marcou's paper, M. Ludwig, one of the associates of Dr. Geinitz, has been to Russia, and has published the results of his researches, under the title 'Geogenische und geognostische Studien auf einer Reise durch Russland und den Ural.' We have not yet seen this work, and therefore cannot say of our own knowledge whether it does or does not bear out M. Marcou's statement that it gives ample facts and sections to show "the inapplicability of the term 'Permian' to the Dyas of Saxony; a term which indeed would not have been for a moment maintained if its typical localities were in a more accessible part of the world."

M. Marcou next considers the necessity of the union of Dyas and Trias into a great geological period—the New Red Sandstone. This period he considers in time and space to be of the same importance as the Grauwacke or Palæozoic, Carboniferous, Secondary, Tertiary, and Recent periods. He has never admitted the union of the New Red Sandstone with the Carboniferous or the Secondary.

Etude sur l'Etage Kimméridien dans les Environs de Montbéliard. By Dr. Ch. Contejean. Leipzig: J. Rothschild. 1860.

Acting on the recognized principle of marking geological periods by particular palæontological faunæ, Dr. Contejean has set about to determine the boundaries and members of the Kimmeridian formation of Montbéliard, and in the Jura, France, and England. To the want of due regard to palæontological evidences, and the too great importance attached to petrographical facies, Dr. Contejean attributes the great number of purely artificial divisions—the limitation of the systematizing of the beds being thus restricted to the mere differences of mineral composition, without due regard to palæontological horizons. In the Jura, the massive "Astarte, Pterocera, and Virgula marls" are ordinarily taken as the base of the Kimmeridge group; upon these are superimposed directly thick intermediate limestones, often sterile or but slightly fossiliferous. These divisions may be strictly conformable to subpelagic regions, where the marly beds alone received the organic débris. "But," well asks Dr. Contejean, "are these good divisions in themselves, and can they be applied more generally?" This question he answers in the negative, and cites the very rich fossiliferous localities of Montbéliard and Ponentruy as evidence. In those regions, formerly littoral, the limestone strata which separate the marls have received the relics of faunas hitherto not appreciated, but which are of equal value with those of the marls, and consequently entitled to rank as independent sub-groups. Moreover, the faunas of certain marl horizons are in no wise different from those of the limestones in their respective vicinities; and thus the natural limits of the divisions are not always restricted either to the base or to the surface of a marl-bed; whilst some limestones belong to two, or even three, different divisions, and therefore if there exist three chief divisions in the Kimméridien formation, the limits of these groups are very different from those which have been assigned to them.

These are the opinions Dr. Contejean has striven to work out in the book before us, and to this end he first describes the geographical range of the Kimmeridge beds, through Damvant, Abbévillers, Audincourt, Montbéliard, and Belfort, in a north-westerly direction; then through the Allan Valley to the district of Ponentruy; and next, south-westwards, to Longvelle and l'Ile-sur-le-Doubs. He then describes the subdivisions, with their mineral characters and their characteristic fossils. These subdivisions are:—(1) *Calcaire à Astartes*; (2) *Calcaire à Natices*; (3) *Marnes à Astartes*; (4) *Calcaires à Terebratules*; (5) *Calcaire à Cardium*; (6) *Calcaires et Marnes à Ptérocères*; (7) *Calcaire à Corbis*; (8) *Calcaires à Mactres*; (9) *Calcaires et Marnes à Virgules*; (10) *Calcaire à Diceras*.

A section of his book is now devoted to detailed lists of the respective faunas of each of these subdivisions, and to comments upon them. After a summary of the facts thus brought forward, he tabulates his results in the following manner:—

ÉTAGE KIMMÉRIDIEN.

IV. Groupe NÉRINÉEN .	Subdivisions to be made out.
III. Groupe VIRGULIEN .	10. s. gr. *Calcaire à Diceras.* 9. *Calcaires et Marnes à Virgules.* 8. *Calcairè à Mactres.* 7. *Calcaire à Corbis.*
II. Groupe PTÉROCÉRIEN	6. *Calcaires et Marnes à Ptérocéras.* 5. *Calcaire à Cardium.* 4. *Calcaire à Terebratules.*
I. Groupe ASTARTIEN .	3. *Marnes à Astartes.* 2. *Calcaire à Natices.* 1. *Calcaire à Astartes.*

The last question then remains—what are the limits of the Kimméridien as thus defined? These Dr. Contejean asserts are exactly indicated. The Kimmeridge division terminates the Jurassic marine series, and is naturally arrested by the Purbeck beds, which most geologists have considered cretaceous, but which the author considers M. Coquand has rightly associated with the Jurassic formation. The inferior limits he sets forth as equally easy to establish, the Kimmeridge division commencing where the mass of fossil corals ends, or immediately above the Diceras beds of the Coralline Oolite.

The fourth section of his work Dr. Contejean devotes to the "Parallelism of the Formation," and notices the characters presented in the Mediterranean basin, Straits of Dijon, Anglo-Parisian basin, and the Pyrenean basin. This is followed by a fifth portion, with geological sections and a general list of the fossils of the whole formation. The remainder of the book, amounting to a hundred pages, is taken up with detailed descriptions of new or critical species of shells, which are illustrated by twenty-four admirable lithographed plates, very carefully and accurately drawn. The book is moreover illustrated by three plates of sections and stratigraphical diagrams of the ranges of the various groups of fossils.

We have, in former reviews, had occasion to speak well of the geological works published by M. Rothschild, but of none we have yet noticed could we desire to speak in higher terms of praise than of Dr. Contejean's admirable monograph before us.

Fig. 1.

Fig. 2.

Fig. 6.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 1. EQUUS CHILENSIS (Molar). 2. EQUUS MACROGNATHUS (Molar). 3. EQU DEVILLII (Molar). 4. HOLOPTYCHIUS (Scale). 5. GLYTOLEPIS (Scale). 6. MICRASTER COR-ANGUINUM, Chalk, Dover.

S. J. Mackie del.

THE GEOLOGIST.

FEBRUARY 1863.

TURTLES IN THE STONESFIELD SLATE.

BY THE EDITOR.

SOME time since, a gentleman handed me, at one of the meetings of the Geologists' Association, a bone from the Stonesfield slate. Unfortunately the label attached to the specimen has been accidentally lost, and consequently I can neither give due credit to its owner for his find nor return the specimen to him as I would wish to do, as his name and address are both thus unknown to me.

The nature of the specimen was very evident, at the first glance, to any practised palæontologist. It is a bone that is peculiarly characteristic of a peculiar class of reptiles which, at the present day, comprises the tortoises, terrapins, and turtles. In short, it is the coracoid bone of some member of the family Chelonia.

Our evidences of this order of reptiles, in strata of Mesozoic age, are few and far between; but Chelonian remains are rare in the

Chelys (?) *Blakii* (n. s.), from the Stonesfield slate.

Secondary beds, chiefly by reason that many of our most productive localities are neglected to be well worked.

The impressions, probably referable to Chelonian animals, which we have in the Triassic sandstones of Corncockle Muir, are at least doubtful, and we shall not insist upon them as evidences here. In the Upper Oolitic slates of Cirin, where a lithographic stone somewhat resembling that of Solenhofen is quarried, there have been discovered remains of emys-like turtles named *Achelonia* and *Hydropelta*. The *Chelone planiceps* has been obtained from the Portland beds, and the curiously complicated and to a certain extent "embryonal" genera *Tretosternon* and *Pleurosternon* from the Purbeck. In the cretaceous beds we have discovered true marine turtles (*Chelone Camperi*, *Chelone Benstedii*, and *Chelone pulchriceps*); a terrapin (*Protemys*) has come from the Kentish Rag of Maidstone (Lower Greensand), whilst many species of small turtle (*Chelone*) are mingled with the phosphatic nodules of the Cambridge Upper Greensand.

This coracoid bone I recently handed to my friend Mr. Carter Blake for further and more complete examination, and he has kindly favoured me with the following note:—

"This specimen consists of the crushed right coracoid bone, viewed from above, of a Chelonian reptile. I have compared it with the homologous bone in the varied kinds of *Chelonia*, and find a form which resembles it very nearly in the Matamata (*Chelys matamata*, Gray). The family of turtles to which the matamata belongs is to be found in ponds and rivers in warm climates. Dr. Gray tells us that they eat flesh, feed only in the water, and when they swim the whole shell is submerged. As however it is believed that the *Trigonia*-bearing Stonesfield slate was a sea-deposit, and as there is no doubt whatever that this fossil is really from that bed, there is some degree of antecedent improbability against its representing a freshwater form. Furthermore, taking into account the manifold variations of form which the coracoid bone exhibits in the Chelonia, there is really no reason, morphological or teleological, why a marine species of turtle may not have existed in the Oolitic sea with a coracoid bone so far differing in shape from that of the existing marine turtles (*Chelone*) as to resemble the homologous bone in the matamata. The turtle of the Oolite co-existed with the *Phascolotherium* and the *Trigonia*, much in the same way as the allied genera of turtles, *Chelymys* and *Chelodina*, co-exist on the same continent with the Australian marsupials, whose remains may be perchance washed into the sea where *Trigonia* still survives.

"Upon one little fractured bone, however, we must not draw any positive conclusions. No doubt, when the Stonesfield slate shall have been more thoroughly explored, further evidences will be afforded. In the meanwhile, without prejudging the question whether the fossil before us be referable to a freshwater or a marine form, I incline slightly to the former opinion."

Remains of scutes of Chelonian reptiles have, since this specimen has been in our hands, been offered for purchase to the officers of the British Museum; but whether they belong to the same species we are not in a position at present to hazard an opinion.

We may add that M. Hugi has discovered in the Kimmeridian beds of Soleure bones of *Emys*, associated with marine mollusca. Pictet suggests that their remains may have been transported by freshwater currents.

As a provisional arrangement, we would prefer to include our specimen in the genus *Chelys*, giving it a characterizing specific name in honour of our friend who has so obligingly worked out its relationship to the other reptiles of the interesting family to which it belongs.

ON THE OCCURRENCE OF GLYPTOLEPIS IN THE SANDSTONE OF DURA DEN.

By the Rev. Hugh Mitchell, M.A.

In his admirable essay on the Devonian Fishes, in the Tenth Decade of the Geological Survey, Professor Huxley has clearly indicated and described the differences and the resemblances of the genera Holoptychius and Glyptolepis. In the interesting work of the Rev. Dr. Anderson on 'Dura Den,' in which its exquisitely-preserved fossils are described, no mention is made of Glyptolepis. In the November part of the 'Journal of the Geological Society of London,' Mr. Powrie has called attention to the occurrence of Glyptolepis in slabs recently disinterred, for the St. Andrew's Museum, from Dura Den. Through the kindness of Dr. Anderson, a slab was presented to the Montrose Museum in 1859; and it is now apparent from it that Glyptolepis is not of rare occurrence at Dura Den, and that either this genus has been passed over altogether, or confounded with Holoptychius. The fishes in the Montrose Museum are smaller, and do not in all points correspond with those described by Mr. Powrie, but we think they emphatically demonstrate that the *Holoptychius Flemingii* must now be denominated Glyptolepis.

On the slab in the Montrose Museum there is one fine specimen of Holoptychius and six specimens of Glyptolepis, not regarding fragmentary portions of fishes. At the first glance there is a resemblance in size, in general aspect, and outline, among the fishes. Their average length is about nine inches, and their breadth at the thickest part of the body nearly three inches. But, on looking more closely, we at once discover the characteristic differences of the genera. The scales of Glyptolepis are far more numerous—apparently as four to one—and are set more closely together and with a deeper imbrication than those of Holoptychius. There is a considerable variety, although nothing of the kind can exceed the beauty of the sculpture of the scales as taken from different parts of the body. The scale of Holoptychius (*all wrinkle*) may be represented by the accompanying figure, Pl. III., fig. 4. It is divided into two portions: the anterior portion, which is smooth, and is covered by the imbrication: and the posterior portion, often deeply sculptured with anastomosing ridges. The scale of Glyptolepis (*carved scale*) may be represented by the accompanying figure, Pl. III., fig. 5, although in this genus there is a greater variety in the sculpturing. It is divided, also, into two portions: the anterior portion, which is covered with a beautiful arrangement of small eminences, radiating in concentric circles from the middle of the scale, and becoming very minute as they approach the margin; and the posterior portion, which is covered with ridges, leaving sometimes a smooth edge on the hinder margin.

The cranial bones of both genera are also sculptured, but with a difference. Those of Holoptychius are covered with a confluent tuberculation, whilst those of Glyptolepis present waving longitudinal ridges.

On the Holoptychius one of the dorsal fins is alone shown, presenting, however, stouter rays than the pendulous corresponding fin of the Glyptolepis. Unfortunately, no comparison can be instituted from this specimen respecting the caudal fins of the genera.

The dentition of the Holoptychius is not seen, but Glyptolepis displays several large teeth intercalated amongst a series of small ones. The medial line along the flank is far more deep and marked in Glyptolepis than in Holoptychius.

From the description given by Mr. Powrie of the St. Andrews specimen, we are led to suppose that two species of Glyptolepis occur at Dura Den—the other much larger than the species we have attempted to describe as above. But one thing is certain, the genus is to be found there. The determining of this matter may cast no new light on the position of the sandstone of Dura Den, but at least it will prevent confusion in the description of its palæontology.

NOTE ON STONE "CELTS" FROM CHIRIQUI.

By Charles Carter Blake, Esq.

(*Read before the Ethnological Society, March* 18, 1862.)

Five stone "celts" have been submitted to me, from the collections of antiquarian objects from Chiriquí formed by my friends William Bollaert, Esq., F.R.G.S., Corr. Mem. Univ. Chile, etc., and W. Duprée, M.D., F.R.G.S., of Panamá.

No information has been given to me respecting the locality, condition, or probable age of these "celts." I understand, however, that they were obtained from the same graves in Chiriquí whence have been derived the various objects wrought in gold and moulded in pottery, some of which have been lately described in the United States, and in this country by Mr. Bollaert.

All the celts exhibited the well-known scalpriform sharpening of the larger end, and are sharpened laterally by a succession of blows, producing facets, analogous to those of the chipped flints which have been found at Abbeville,* at the Kjökkenmöddings in Denmark† and in various European localities, and which probably belong to a period antecedent to the known historical era.

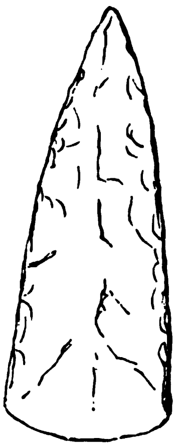


Fig. B 1.

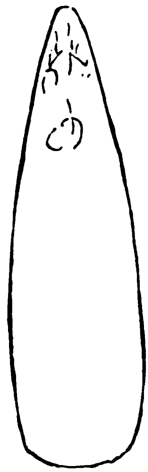


Fig. D 2

Four of the celts, marked B 2, B 3, D 1, and D 2, are composed of the porphyritic stone found in great abundance on the Isthmus of Darien. One only, marked B 1, is hewn more roughly than the others from an indurated clay, and closely resembles some of the European worked flints.

B 1 (measuring $4\frac{4}{10}$ inches) is of a tapering acuminate form, the lateral facets being so deep, and so widely extending across the celt, as to have produced a more or less salient ridge, extending longitudinally along the median line of the celt. The larger end is polished on either side for a small extent up the hatchet. The stone, however, by its porous nature, has not been susceptible of much polish. The smaller end is prolonged to an acute point.

Fig. B 3.

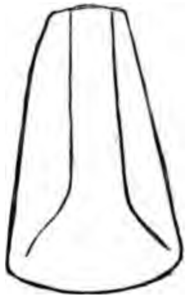


Fig. D 1.

D 2 (measuring $3\frac{3}{10}$ inches). The sculptor's art has in this celt progressed to such an extent as to produce a polished surface, obliterating the facets, and extending over the whole stone, with the exception of the acuminated but unsharpened smaller extremity.

In the three following "celts" the longitudinal diameter is much less than in the two above mentioned.

* Prestwich, Phil. Trans., 1860. Evans, 'Archæologia,' 1860, 1862.

† Natural Hist. Review, Oct. 1861.

B 3 (measuring 4 inches). The surface of this stone has been polished to a greater extent than in D 2. The smaller end is not only polished, but has its tapering extremity rounded off. Subsequently to the polishing process, the lateral portions have been submitted to the action of some substance which has rubbed and ground off the polished surface, apparently with a view of rendering the sides more acute.

D 1 (measuring $3\frac{4}{10}$ inches). A similar process has been exercised on this specimen, on the lateral portions, whilst along the median line, the ridge, which was so prominent a feature in B 1, has been artificially obliterated. The polished portion extends a small distance up the blade. The acuminated point has been broken away, exhibiting a hexagonal fracture.

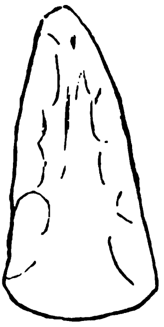


Fig. B 2.

B 2 (measuring $3\frac{2}{10}$ inches). This celt, of a lighter porphyry than the others, presents the facet-shaped arrangement of the lateral portions, which is exhibited to a greater extent in B 1. It is polished at the sharp extremity. The acuminated extremity is obtusely rounded; near it, a deeper facet than the rest is removed, with the probable purpose of rendering more firm its attachment by some ligature to its handle. No such device is found in the four other celts.

The above five celts, therefore, offer each distinctive characters, and probably indicate different fashions and patterns of the sculptor's, or rather cutler's, art in Chiriquí. The specimen B 1, by its rough facets, its slight degree of polish, its general flat appearance, and its comparative simplicity of workmanship, seems to indicate its being the product of a nation not much superior in civilization to the denizens of the Kjökkenmöddings in Denmark. Reasonable ground of doubt may exist as to whether it belongs to the same era as the four porphyritic celts. The nation which produced such works of art as some of the Chiriquí pottery and gold objects, would surely have arrived at a higher degree of perfection in its weapons. It is undoubtedly, also, a finished celt, complete as far as its maker intended it to be—not a mere spoilt model, thrown aside. The absence of proof respecting its actual collocation with the Chiriquí antiquities, would lead me to assign to it a far higher historical remoteness, and render it possibly coeval with the remains of the old short-headed (brachycephalic) mound-builders of Natchez, whose epoch in time antiquarian archæology in North America has as yet been unable to ascertain.

The four porphyritic celts have no such distinctive characters. They might be the work of the earliest inhabitants of Chiriquí, or the product of the idle Indian of the present year.

A careful examination of the various types of celts, as denoting distinctness of race, has led me to the conviction that the Chiriquí celts are entirely *sui generis*. They differ from the more heavy cut-ery of the mound-building Natchez in their less weight and their nore acuminated form. A sketch from Squier's 'Monuments of the Mississippi Valley' indicates the size of the celts of the short-headed nound-builders. It was six by four inches, and weighed about two ›ounds. It is undoubtedly a finished celt. Upon a comparison of he Chiriquí celts with the obsidian knives from Mexico, no resemblance exists. Their closest analogy is with the hatchets from the tone mounds of Denmark. Dr. Troyon has observed that "man, laced under analogous circumstances, acts in an analogous manner, rrespective of time or place." We thus have analogous flints from vholly distinct parts of the world.* Whether these evidences indicate he once almost universal dispersion, antecedent to the historical poch of whole nations of men, little elevated above the animals, rhose remains have been preserved to us in strata often containing he débris of extinct mammalia, I must leave to this Society to deternine. The antiquity of the human race in America, inferred from he existence of so many native traditions of the *rapports* which early nan once bore to the extinct animals, is thus rendered more probable y the antiquarian evidences now afforded us.

I cannot close this paper without expressing my sincere regret that 10 osseous or cranial remains have been afforded us of the aborigines f Chiriquí and Panamá. Such proof can alone conclusively demontrate the true affinities of nations, or the probable era when they xisted. Mere archæological evidence is an uncertain guide.

In conclusion, I beg to remark, that at first sight the mere degree f chipping which a flint might have undergone at human hands might eem a trivial subject of discourse; but when we reflect upon the phorism of Sir Thomas Browne, that "Time conferreth a dignity ipon the most trifling thing that resisteth his power," the study of hese carved stones from Chiriquí becomes fraught with considerations f the highest mental value.

REPORT OF A SUCCESSFUL SEARCH FOR FLINT-IMPLEMENTS IN A CAVE CALLED "THE OYLE," NEAR TENBY, SOUTH WALES, IN JUNE AND JULY, 1862.

BY GILBERT N. SMITH, RECTOR OF GUMFRESTON.

(*Read at the Cambridge Meeting of the British Association*, 1862.)

This is a cave in the Mountain Limestone, with a wide entrance ooking to the north-east at about 70 feet above the level of the 'alley beneath, up which the tide has recently flowed. The cave xtends tortuously for 30 or 40 yards into the axis of a ridge which s a spur of the "Ridgeway," extending from Pembroke to Tenby, omposed of the Old Red, the strike of which is east and west.

* Boucher de Perthes (*Antiquités Celtiques et Antédiluviennes*, 8vo, ii. 282) describes a series of analogous half-polished hatchets, as appertaining to the "transition"

Within, the cave is distinguished by chambers, alternating with narrow passages. The floor is generally not more than three feet deep, at which depth the limestone is met with as at the roof and sides. The entrance being conspicuous, it is often visited from curiosity, but has never before been carefully explored for the definite purpose of discovering works of ancient art. This search was prompted by the recent discoveries in France and at Hoxne, strongly seconded by the fact that above, on the Ridgeway, some six or seven barrows exist, which yielded to the reporter and others a few years since, not only cinerary urns, but also well-shaped flint arrow-heads.

So much by way of introduction.

The Section will be glad to learn that the search in this cave for flint weapons has been successful, and that the number found is seventy-three, including the identical lumps of flint which remained after the chips had been struck off, when from their reduced size they were no longer capable of yielding flakes sufficiently large to answer the destined purpose, whatever that might be.

Some of these specimens are of ordinary flint, but a good many are of a dull-green opaque chert. In size they vary from about four inches in length, downward. In general form they are almost identical with the flakes found at Red Hill. They were disseminated through the soil, but much the most thickly scattered at the mouth of a recess near the entrance, where the fabricator might be supposed to have seated himself to take advantage of the light.

Interspersed also through the soil, which in some places is almost black, were a great many bones; most of them those of ruminants, such as are now domesticated; some of them fish-bones, with the shells of edible mollusks; and some few unmistakably the remains of cave-mammals, such as *Ursus spelæus*, *Equus caballus*, *Hyæna spelæa*, and the teeth of some species of deer. Of this last animal, though apparently of a later age, there is one very fine front prong of an antler, which measures 11 inches, and the circumference 4¼ inches at the base, where there are long marks across as if done with some tool. To these works of ancient art and animal remains must be added some very modern articles; one of them the half of a Sheffield penknife, which, however, seemed to have been buried some years.

The conclusions and inferences which the author of this report has come to will be comprehended in replies to the following questions:— 1st. What was the use of these flakes? 2. By what race of men were they fabricated? 3. Whence was the material derived?

First, the use of these flint, and chert flakes. The conviction ar-

period between the pre-historical and the Celtic nations. He describes one of these "celts" as "*une hache à gaîne ou demi-polie. Le tranchant l'est entièrement. La partie destinée à entrer dans la gaîne ne l'est pas.*"

In the British Museum collection of antiquities, an object, termed by Mr. Bollaert a "stone club," is preserved from Cocina, in Peru, near Noria. Mr. Gilbert Brandon has also preserved a "stone hatchet-blade used in the time of the Incas," from Cuzco; whilst amongst the Mexican antiquities presented by Lady Webster, is to be found a "*cincel de los Indios, encontrado en una sepultura,*"—where, is not stated.

rived at from a general view of them scattered upon the table, whether found in "the Oyle," at Red Hill, or elsewhere, is that these chips are the rejected refuse of the workshop. "On this spot," the thoughtful observer is disposed to say, "some weapons or implements were fabricated on some one or more occasions; and while the perfected ones were carried away, these inartistic though somewhat shapely fragments were left on the floor where they fell, and at length became buried, partly by the tramp of animals, and partly by accidents of daily human life." I feel sure of this conclusion, not only because most of the flint chips which we have in collections (as that handful, for instance, in the British Museum, which are said to have come from Arabia) are in reality nothing but primary splinters, which have never received a second perfecting stroke or trimming from the hand, but also from the following argument:—

Assuming these to be mis-shapen chips struck off on the spot, would there not be found among so many one or two perfected specimens of the tools or weapons assigned? This is very probable—almost certain; but not so probable as that some broken specimen of the tools, broken in the process of completion, would occur here and there. And so it proves in this case; for among these seventy-three specimens, there are eight broken pieces which have received much manipulation, and have heads elaborately rounded off, by removing small conchoidal scales. And further, the lumps of flint which have been split up as long as they would yield flakes strengthen the argument; for they, too, are left behind commingled with the rest of the abandoned fragments.

Secondly, by what race of men were these implements fabricated? The reporter, supposing these chips to be ancient, has no hesitation in ascribing them to the same natives of Britain by whom the tumuli on the Ridgeway above were raised, and who buried with their dead the flint arrow-heads found within those mounds. No other supposition obviously needs to be entertained.

But who were this race of men? The world say, "Britons, to be sure; these are British barrows, and those vases on your shelf are British urns that you obtained from them."

Well, let us suppose so for a while. But surely, if such is the case, these descendants of the British who live around "the Oyle" and the barrows here in Wales, and who certainly are in possession of much ancient literature, while the Saxons brought us next to none, would be able to inform us whether their ancestors ever used flint tools or weapons in early days, especially as the records relate to the very first possession of the island by the race of Adam. Led by this thought, I have corresponded with the ablest Welsh archæologists, and have been favoured with full replies; but all deny that their forefathers ever used anything but bronze and iron for war or in the chase, but say that there is a notice or two in their very early documents of the use of flint knives for sacrificial purposes only. This admission, however, proves nothing; for other races of men,—the Jews, for instance,—while they certainly had tools of metal, uniformly employed flint knives in sacrificing animals, and for circumcision. From this absence of all reference to flint or stone weapons in the earliest writings of the Welsh, it seems to follow, either that the writings cannot be depended upon to supply precise information, or that the men who made the flint weapons were of another race, possibly much earlier inhabitants of the island.

Thirdly, whence was the material obtained? There are no flints in the formations and strata of the vicinity,—that is certain. But then they may be picked up any day by a careful search on the shore; and so may granite boulders and worn fragments of igneous rocks.

The chert of these implements is peculiar. It is of a dull, opaque green colour, full of minute grey spots. I do not at present know of any like it in these parts; but one lump, tide-borne to the coast, would have supplied all required for the sixteen fragments of this kind found.

CORRESPONDENCE.

Age of the Blackdown Greensand.

Sir,—The question as to the true position in the Greensand series of the "Whetstone" deposits of Blackdown, in Devonshire, is one which, so long as it remains uncertain, must naturally force itself upon every geologist who either studies or collects the fossils of the Greensand formation; and, therefore, although this question is neither new nor of universal importance, I trust that I may be permitted to refer to it in the present instance.

The question is simply this—Are these (Blackdown) deposits equivalent to the Upper Greensand, to the Gault, or to a portion of the Lower Greensand? or do they represent the whole of these in an exceptional form?

In parts of Kent or Surrey, where the Lower Greensand strata rest upon Weald clay, and are everywhere separated from those of the Upper Greensand by an intervening bed of Gault, such a question would be readily determined. But at Blackdown the case is different, the Greensand being there found to rest upon red marl, and the Gault either absent or imperfectly developed; so that, in default of the usual direct evidence, the geologist must be content with such indirect conclusions as can be drawn either from the general appearance of the deposits or from a comparison of the organic remains with those contained in other portions of the Cretaceous series. Whether or not this last method has been carried out by those who consider the Blackdown deposits to be of Upper Greensand age, I have not hitherto been able to ascertain.

In the British Museum all the Blackdown fossils are marked as Upper Greensand, in the Museum of Practical Geology, more cautiously, as Greensand; while in both they are ranged side by side with fossils from Warminster,—a locality where the Upper Greensand is well defined by the presence of the Gault. Now, supposing Upper Greensand deposits to prevail equally at Blackdown and Warminster, one might expect to find a considerable resemblance between the fossils from these two localities; yet, on comparing the specimens, the fact proves itself to be quite the reverse; for, at a rough computation, I find that out of 156* Blackdown

* These and the following numbers refer to Mollusca only.

Map of the Greensand Sea.

(BLACKDOWN AGE.)

nollusca, 6 only occur at Warminster, the remaining 30 Warmin- not being found at Blackdown. A further comparison of the fossil mollusca with those of the Upper Greensand generally, ith the fossil mollusca of the Gault, gave nearly the same result. servations, combined with certain facts which came under my studying the Lower Greensand of Surrey and the Isle of Wight, the first place, to question the correctness of classing the Black- sits with those of the *Upper* Greensand or even of the Gault; tely induced me to believe them, so far at least as the whet- are concerned, to be exclusively of Lower Greensand origin— ion in the series being, probably, near the base of the upper or division of Fitton.

refore, in the hope of stimulating further inquiries, which, for ave neither the time nor the opportunity to make, that I now address you on the subject, as I feel convinced that a closer on of the lowest beds of the Greensand at Blackdown must now question; for, should the absence of Gault be confirmed, I think e of the fossils alone may be deemed conclusive.

wing table shows the relation of the Blackdown fossils to those er Greensand, Gault, and Lower Greensand respectively:— umber of Blackdown species (Mollusca) taken from 'Morris's Fitton's List in Trans. Geol. Society, and from specimens in Museum and Jermyn Street Museum, 156. Of these, 81 are Blackdown; 20 occur in Upper Greensand, 7 of which are li- pper Greensand and Blackdown; 16 occur in Gault, 4 of which to Gault and Blackdown; 59 occur in Lower Greensand, 39 of imited to Lower Greensand and Blackdown.

bers for comparison, therefore, stand thus:—

ecies limited to Upper Greensand and Blackdown, 7; *viz.*—

onites denarius . .	Not common (Sow.).
lcatus	A rare species (Sow.)
n asper	Abundant in G. S. near Frome.
ratula lyra . . .	Rare.
itella granulata . .	Abundant at Blackdown; U. G. S., locality doubtful.
hæa vesiculosa . .	Abundant in U. G. S., near Warminster; Blackdown, doubtful.
llæa carinata . . .	Common at Blackdown; occurs in U.G.S., near Devizes.

Species limited to Gault and Blackdown, 4; *viz.*—

onites auritus . . .	Not common (Sow.).
berculatus	
x calcar	Common at Blackdown; other localities doubtful.
ellaria calcarata . .	Common at Blackdown and Folkestone.

ecies limited to Lower Greensand and Blackdown, 39; *viz.*—

	Lower Greensand locality.	
rte formosa . . .	Shanklin	Rare.
ovata	Sandown.	
ula Rauliniana . .	Godalming.	
ium Hillanum . .	Shanklin	Frequent.
ula truncata . . .	Peasemarsh	Common.
egans	Peasemarsh	Common.

Cucullæa glabra	Shanklin and Peasemarsh	Rare.
Cyprina angulata	Hythe and Sandgate.	
C. rostrata	Atherfield.	
Cytherea (Venus) caperata	Atherfield.	
Venus faba	Shanklin and Peasemarsh	Common.
V. ovalis	Peasemarsh	Rare.
Exogyra undulata	Godalming	Rare.
Gervillia anceps	Peasemarsh.	
G. lanceolata	Atherfield.	
G. solenoides		
Lima semisulcata	Shanklin	Common.
Nucula antiquata	Atherfield.	
N. impressa	Parham Park.	
N. lineata	Shanklin.	
N. obtusa	Atherfield.	
Tellina inæqualis	Shanklin and Peasemarsh.	
T. (Psammobia) striatula	Shanklin and Peasemarsh.	
Thetis minor	Shanklin and Peasemarsh	Common.
Trigonia dædalæa	Parham Park.	
T. spectabilis		
T. caudata	Atherfield.	
Littorina pungens	Peasemarsh.	
L. conica	Peasemarsh and Shanklin	Common.
L. (Natica) monilifera	Peasemarsh	Rare.
L. (Natica) rotundata		Common.
Phasianella formosa	Peasemarsh	Rare.
P. striata	Peasemarsh	Rare.
Turbo munitus		
Nautilus elegans	Godalming.	
Dentalium medium	Peasemarsh.	
Serpula filiformis	Shanklin.	
S. plexus		
Vermetus polygonalis	Hythe and Sandgate.	

From the above list, it is apparent that the Upper Greensand and Gault fossils which occur at Blackdown are but few, and of small value when compared with those of the Lower Greensand.

There are circumstances connected with the accumulation and deposition of the strata forming the Lower Greensand generally, which may also be taken into account in considering this question; some of which I shall now proceed to notice.

It has been shown by Dr. Fitton, that the Lower Greensand, wherever fully developed, is separable into three groups or series of strata; each differing somewhat from the others in mineral character, and each possessing a fauna more or less peculiar to itself. Now, although the limits of each are not everywhere traceable, yet there is always a sufficient distinctness between them to warrant the belief that the same causes, whether of upheaval or depression, acted throughout the entire British area then covered by the Greensand ocean.

In the neighbourhood of Godalming this subdivision is, perhaps, more strongly marked than is usually the case. The lower Neocomian clays are here found, as elsewhere, resting conformably upon the Wealden. They are succeeded by a series of strata, composed, for the most part, of fine sand, mingled with more or less argillaceous matter, and including occasional bands of loose, concretionary sandstone; this latter being, apparently, a local equivalent of the Kentish rag of Maidstone. All these appear to have been deposited quietly and continuously, and form, including the lower Neocomian clay strata, "the Middle and Lower division" of Fitton.

Here, however, there is an abrupt change. The finely stratified deposits which have hitherto prevailed are overlaid by an accumulation of coarse sand and *pebbles*; the stratum or strata composed of these materials varying in thickness from a few inches to six or ten feet, and contrasting strongly with the sands beneath. The "pebble-beds" are succeeded by various strata of coarse gritty sand, abounding in concretions of limestone* and chert; in all of which small pebbles and thin layers of clay are of frequent occurrence. These, in turn, are followed by a series of ferruginous sandy deposits of considerable thickness, which range upwards uninterruptedly to the Gault.

It is to the occurrence of these "pebble-beds" and of the superincumbent limestone, in the Greensand of Godalming and elsewhere,† that I would now direct attention, as being possibly connected with the present subject of inquiry.

There is another subject, however, so closely connected with every question relating to the Greensand, that I find myself compelled to notice it before proceeding further.

Mr. R. Godwin-Austen, in a valuable paper "On the possible Extension of the Coal-measures beneath the South-Eastern part of England,"‡ argues the existence, during the Oolitic, Wealden, and Neocomian period, of a *ridge of old rocks* (palæozoic) extending across our south-eastern counties nearly in the line of the North Downs. This ridge the author traces eastward, in connection with a well-marked Continental axis, called by him the "Axis of Artois," and westward, into the district of Bath and Frome. For the capital reasoning upon which that author's supposition is founded, I must refer the reader to the original paper. Yet it cannot fail to strike the observer, that such a ridge, supposing it to have existed as a coast-line during a lengthened period, must have exercised considerable local influence upon the surrounding deposits, whether of the Oolitic or Cretaceous formation; so that the surrounding deposits ought, in themselves, to contain some direct proof of its existence. Such proof, if I mistake not, may really be found in the "pebble-beds" of the Lower Greensand. Of these, Mr. Austen says, "The shingle-beds of the Lower Greensand of Kent and Surrey contain a considerable number of extraneous fossils, such as the bones and teeth of Oolitic saurians, *Ammonites Lamberti* and *Am. crenatus* of the Oxford clay in great abundance, together with *Terebratula fimbria* and *Rhynchonella oolitica;*" and instances these as having been derived from the wearing away of members of the Oolitic group, which, he suggests, may have been originally brought up against the southern slope of this old ridge "by a process of successive overlap."

In confirmation of this opinion I may here mention that, previously to becoming aware of Mr. Austen's researches, I had obtained from the "pebble-beds" of the Lower Greensand of Godalming a series of drifted fossils, ranging in age from the Oxford clay to the Lias inclusive; and, from the evidence of these alone, I had come to the conclusion, that at the time of their deposition in the Greensand the rocks from whence they were derived must have existed within a short distance to the northward.§

* Locally called "Bargate stone."

† Along the North Downs. A pebble-bed also occurs in the cliff north of Shanklin chine, holding exactly the same position in the Greensand.

‡ Quar. Jour. Geol. Soc. vol. xii. p. 50.

§ My reason for looking northward for such land-surface arose partly from the fact of the pebble-beds becoming gradually thicker, and their component parts coarser, in that direction.

In addition to the fossils mentioned above, I have collected from these "pebble-beds" specimens of the teeth of—

Saurichthys apicalis . .	Fossils of the Trias of Aust cliff and the Lias bone-bed at Axmouth.
S. Mougeoti	
S. ?	
Hybodus Minor	
Acrodus minimus . . .	
Hybodus pyramidalis . .	Fossils of the Lias.
H. reticulatus	
H. grassiconus.	
H. ?	
Lepidotus (two or more species in abundance).	
Sphærodus ?	
Gyrodus.	
Pycnodus Mantelli.	
Acrodus.	
Strophodus ?	
Lamna longidens.	
Notidans.	

and some others. The greater number of these specimens are more or less broken; yet many of them are by far too perfect and delicate to have been drifted from a distance. I have also, from the same deposits, casts of about thirty species of small univalve and bivalve shells, which, at present, I have had no opportunity of identifying.

The "pebble-beds," therefore, appear to offer double evidence in regard to this "old ridge:" firstly, in affording a proof of its existence as a coast-line; and secondly, in pointing out a time of its partial submergence: with the latter evidence I have now to do.

A thin stratum of sand, clay, and *pebbles* (described by Fitton as a "kind of gravel"), occurs at the base of the Lower Greensand, at its junction with the Wealden. Again, the basement-bed of the Gault, as at Redcliffe, contains numerous *subangular pebbles.* In both of these cases the pebbly strata represent a change in the relative level of land and water, sufficiently extensive to have altered the character of the succeeding deposits; and thus it seems probable that the "pebble-beds" at the base of the upper division of the Lower Greensand represent a similar disturbance; the effect of which, I think, may be easily traced.

No Greensand deposits older than the "upper" or ferruginous division of Fitton are found to the west of a line drawn from Warminster to the Isle of Purbeck, or north of a line passing from Dover, through Rochester, Croydon, Kingsclere (Hants), and then on to Warminster, or, in other words, north of Godwin-Austen's "old ridge." Greensand deposits, however, corresponding to Fitton's upper division, are found greatly to exceed these limits, both on the north and west. It appears, therefore, to be tolerably certain that the "pebble-beds" at the base of the ferruginous division represent, and are the immediate result of, a period of considerable depression, during which the Lower Greensand ocean extended itself far to the northward, across a portion of the "old ridge," and westward into Devonshire. By supposing this ridge to have been cut through or partially submerged at this period, one difficulty, at least, as regards the "pebble-beds," will be done away with—viz. that of the occurrence in one stratum of the fossils of several separate formations. For, supposing such a ridge to have existed as a land-surface from a period prior to the deposition of the Lias, every succeeding deposit must have been brought up against it, as has been suggested by Mr. Austen; and, consequently, an oceanic current, in crossing this line, would act upon the edges of these various deposits, and thus mingle in one stratum the débris of many. It would, further, serve to connect the "pebble-beds" of Surrey with similar deposits in the Lower Greensand near Devizes, and also with such part (at least) of the Faringdon gravels as are generally recognized as of Lower Greensand age. The mineral character is the same in each, and the fossils are also found to bear a close resemblance. The "pebble-beds" of Godalming contain *Rhynchonella depressa*, *R. latissima*, *R. nuciformis*, *Terebratula Nerviensis*, *T. oblonga*, *T. faba*, *T. ovata*, (?) *T. tamarindus*—the first four rarely, the latter in abundance; all of which species have been found at Seend, near Devizes, and also at Farringdon.

To the first part of this argument—viz. a northern, or rather north-eastern, extension of the Greensand at this period, no objection is likely to be made. A western extension at the same period, however, does not so readily admit of proof; yet it is so very probable, that, for the sake of argument, I will suppose the fact to be admitted. In which case, the lowest beds of the Greensand in Dorset and Devonshire would be nearly equivalent in age to the "pebble-beds" of Godalming; and the position of the "Whetstone" beds of Blackdown, from which the greater portion of the Blackdown fossils are obtained, would correspond with the concretionary, siliceous, and calcareous deposits which so frequently occur near the base of the ferruginous division of the Lower Greensand of Kent and Surrey, etc. As, for instance, the concretions in the cliffs between Folkestone and Copt Point, described by Fitton as "in part consisting of siliceous, spongy stone, like the Whetstone of Devonshire;" the Bargate stone of Godalming, in which siliceous, spongy concretions also occur; the siliceous and ferruginous concretions in the cliff, which form the upper part of Shanklin chine, and the ferruginous nodules in the Greensand at Parham Park. The fossils from these localities, though few in number, are mostly such as occur at Blackdown. Thus, from the Bargate stone of Godalming, in which shells are very scarce, I have obtained *Avicula Rauliniana*, *Exogyra undata*, and *E. undulata*; from Shanklin, *Astarte formosa*, *Cardium Hillanum*, *Psammobia striatula*, *Tellina inæqualis*, *Gervillia lanceolata*, *Thetis minor*, *T. lævigata*, *Venus faba*, *Lima semisulcata*, *Nucula impressa*, *N. lineata*, *Pecten quinquecostatus*, *Pinna tetragona*, *Corbula elegans*, *Trigonia caudata*, *Littorina conica*, *L. monilifera*, and *L. rotundata*. In fact, these last-named deposits contain a greater percentage of Blackdown fossils than occur in any other portion of the Cretaceous series; and this, alone, is in itself the strongest argument which could be used in favour of the Lower Greensand age of the Whetstone deposits.

In the accompanying map I have endeavoured to show the probable position of land and water at two distinct periods: the darker shading represents the probable extent of the greensand ocean over our south-eastern counties during the accumulation of those deposits which are included in Fitton's middle and lower division; the lighter shading exhibits its further extension to the north-east and west, during and after the accumulation of the "pebble-beds," and previously to the deposition of the Gault.

In this map Mr. Godwin-Austen's "old ridge" forms the northern boundary of the Greensand during the first period. At the second period the greensand is seen on the north—the ridge being partially submerged. It is probable that this ridge became wholly submerged during or immediately before the deposition of the Gault.

Allowing the position of the land-surface to have been as above stated, the abundance of the Blackdown fossils, as compared with those in the upper division of the Greensand in Surrey, etc., would not be at all surprising; for the position of Blackdown, near the end of a narrow inland bay, would have been, of all others, the most favourable one for the increase of mollusca.—I am, Sir, yours, etc., C. J. A. MEYER.

Godalming, Surrey.

Elephas Texianus v. *Columbi.*

SIR,—Reference has already been made by me to the above subject in the pages of the 'Geologist.'* The nomenclature which I have used, and the inferences which I have drawn, having been impugned in an elaborate paper by Dr. Falconer,† a few lines in their justification may be permitted.

When, in February, 1858, the tooth in question was shown to me by my friend Mr. Bollaert, the most casual observation was sufficient to demonstrate that it was of a different species to the Mammoth (*E. primigenius*). In the dearth of published information on the subject I consulted the works of Cuvier,‡ Humboldt,§ Leidy,‖ De Blainville,¶ Carpenter,** Lartet,†† and others, and especially the memoir of Dr. Falconer.‡‡ I endeavoured in the paper on the Texan Elephant to acknowledge the benefits to proboscidean science derived from his "most complete, elaborate, and philosophical conspectus."

Upon attempting, with the "Bollaert molar" in my hand, to discover in this memoir any specific description of this form, my efforts resulted in disappointment. Dr. Falconer, in the above-cited memoir, divided his subgenus *Euelephas* into four divisions. The first he characterizes as having "*Colliculi subremoti, adamante crassiusculo.*" The solitary species belonging to it is the Miocene *E. Hysudricus*. The second division (*Colliculi approximati, medio leviter dilatati, machæridibus undulatis*) includes *E. antiquus* and *E. Namadicus*. The third division (*Colliculi approximati, machæridibus valde undulatis*) includes *E. Columbi*, *E. Indicus*, and *E. Armeniacus*. The fourth division (*Colliculi confertissimi, adamante valde attenuato, machæridibus vix undulatis*), has for its solitary representative the mammoth (*E. primigenius*).

The name *E. Columbi* has the following notes added to it in Dr. Falconer's Synoptical Table:—

Geological Age.	*Country.*	*Remarks.*
Post-pliocene?	Mexico. Georgia. Alabama.	An syn. *E. Jacksoni?* Sillim. Journ., 1838, vol. xxxiv. p. 363.

In the second part of his paper, which was read before the Geological Society on June 3, 1857,§§ Dr. Falconer concluded with a few remarks on the non-existence of *E. primigenius* south of the Alps, and its restric-

* Geologist, vol. iv. p. 470; vol. v. pp. 57 and 323.

† 'On the American Fossil Elephant of the Regions bordering on the Gulf of Mexico (*E. Columbi*, Falconer), with General Observations on the Living and Extinct Species.' Natural History Review, January, 1863.

‡ Ossemens Fossiles, ed. 1834, vol. iv. p. 145.

§ Cosmos, vol. i. p. 280.

‖ Nebraska Fauna, p. 9.

¶ Ostéographie, Eléphans, p. 157.

** Silliman's Journal, second series, vol. i. p. 244.

†† Bull. Geol. 1859, p. 469.

‡‡ Quarterly Journal Geol Soc., 1857, p. 319; 1858, p. 81.

§§ Quarterly Journal Geol. Soc., vol. xiv., 1858, p. 81.

tion in the United States of America to the Northern and Central States. "In the Southern States and Mexico, a distinct fossil species, *E. (Euelephas) Columbi*, hitherto undescribed, occurs along with remains of *Mastodon*, *Mylodon*, *Megatherium*, horse, etc."

Dr. Falconer tells us,* that by the above description "the leading points of the dental characters and the precise place in the natural series occupied by the species were distinctly indicated, together with its range of habitat, along a stretch of nearly 20° of longitude in the regions bordering the Gulf of Mexico."

Apart from the incongruity of the assertion that Georgia is included in the "regions bordering the Gulf of Mexico," I cannot perceive in Dr. Falconer's group-characters, "*Colliculi approximati, machæridibus valde undulatis*," such a definition of the specific signification of *E. Columbi* as is imperatively demanded at the hands of the founder of a new species. The mere insertion of the above notice in a catalogue, I have already ventured to suggest, was not a valid definition. Still less was it so, when in the column of remarks the following bewildering announcement was inserted, "An Syn. *E. Jacksoni?* Silliman's Journal, 1838, vol. xxxiv. p. 363." The worthlessness of the representations here contained has been already commented on by me, and Dr. Falconer admits that the only published drawing possibly attributable to *E. Columbi*, to which he was able to refer at the time of his memoir in 1857, was "too imperfect to be reliable for more than a conjecture."†

Dr. Falconer, criticizing my specific definition of *E. Texianus* (*dentium molarium* (m. 6), *colliculi undulati, magis remoti quam in E. Indico*), says that he fails "to detect a single term or character which is not either expressed, embodied, or implied, in his Synoptical Table above referred to." I, however, have searched this table most carefully for any hint that the "*colliculi*, or constituent ridges of the unworn teeth," in *E. Columbi* are further apart (*magis remoti*) than in the Indian elephant, and do not discover any such implication. Dr. Falconer, in his later memoir, subsequently to the publication of my paper,‡ speaking of the Mexican molar in the College of Surgeons, says: "The disks of wear are wide and open, wider than in the ordinary varieties of the existing Indian elephant, and approaching the width commonly presented by *E. antiquus*. But they differ from those of the latter species in showing no angular expansion in the middle of the disks, and no outlying loop at the angles. In this respect they correspond more with the disks of the existing Indian elephant."

In the quotation from my published paper to which Dr. Falconer refers on page 48 of his memoir, a grave orthographical blunder has been inserted, which is not found in the original, as may be seen by those who compare Dr. Falconer's version with page 58 of the 'Geologist' for 1862. I have there said that "as it is not clear whether *E. Columbi* is named in honour of Columbus, or because it is found in Colombia (Venezuela y Nueva Granada), I trust that this name will not be accepted." In the passage, which purports to be a faithful and literal quotation of my words, the word Colombia has been altered to Columbia, and my meaning has been rendered open to misconstruction on the part of those who might consider me guilty of the orthographical solecism which Dr. Falconer has attributed to me.

But Dr. Falconer goes on to say, that Columbia (meaning Colombia) was "nowhere in question as a habitat of the species." I confess I am a little surprised at this statement, seeing that the frequent presence of Mastodon remains in the plateaux of New Granada has been discussed;

* Nat. Hist. Review, vol. iii. p. 45. † Id. p. 57. ‡ Page 50.

that in September, 1858, Professor Owen had speculated on the possibility of evidences of proboscidean life "at the expense of the still more luxuriant vegetation watered by the Oronoko, the Essequibo," etc.;* that in districts even more remote than Colombia, Dr. Falconer, on the testimony of M. Lartet,† has arrived at the conclusion that it is possible that *E. Columbi* may have even reached so far south-east as Cayenne, in latitude 4° 56′ N., and longitude 52° 8′ W., and that a doubtful evidence of true elephantine remains was discovered by Humboldt in the province of Quito.

With respect to the "jactitation" and "accommodating arrangements" which Dr. Falconer presumes to exist between Professor Owen and myself, respecting the synonymy, the simple fact to which I alluded in my paper—that I had examined the tooth in February, 1858, and when I had arrived at a definite opinion as to its position in the Elephantine series, Professor Owen, in his address to the British Association, thought fit to adopt my name—affords a satisfactory explanation of the alleged discrepancy.

I was necessarily ignorant of the private information placed at Dr. Falconer's disposal at various periods of time, ranging from the year 1846 to the present year, by Sir Charles Lyell, M. Humbert, Messrs. Norton, Guild, and others, when my memoir was published. I however made due reference to the milk-molar brought by M. Le Clerc from Texas, now in the Paris Museum, as possibly belonging to the same species as *E. Texianus*. Two of the specimens from the Huff collection in the British Museum, which I had been inclined to refer to *E. primigenius*, are considered by Dr. Falconer to belong to *E. Columbi*. The other colossal remains are admitted by him to be indistinguishable from *E. primigenius*. The specimen No. 741A, in the Museum of the Royal College of Surgeons, I have examined carefully since the publication of Dr. Falconer's paper, and I have no hesitation in recognizing it as referable to *E. Texianus*.

When speaking of the "Bollaert molar," Dr. Falconer states that "some of the plates show a considerable amount of undulation in the general sweep of the *machærides*, but there is no tendency to the mesial expansion, or outlying loop, seen in *Elephas antiquus*."‡ The degree of mesial expansion in *E. antiquus* (*medio leviter dilatati*, Syn. Table) seems to be scarcely defined. According to Lartet,§ who describes *E. meridionalis* as a separate species, "leur émail, irrégulièrement festonné, offre le plus souvent une expansion médiane simple ou double, qui rappelle, jusqu'à un certain point, les figures rhomboïdales que la détrition produit sur les molaires de l'éléphant d'Afrique." Lartet, describing the *E. antiquus*, says, "émail moins épais et plus régulièrement festonné, avec ou sans expansion médiane." With due respect to Dr. Falconer's elaborate description of this "magnificent morceau," I can detect in the fourth and fifth ridges of the tooth, or the second and third of the seven ridges which are "bounded by highly crimped and thick plates of enamel," evident traces of a mesial expansion, which may be considered *pro tanto* homologous with that of *E. antiquus*, so far as the definition of a "mesial expansion" in that species is capable of comprehension. A slight mesial expansion may also be seen in the seventh ridge of the Mexican molar in the College of Surgeons.

Dr. Falconer's criticisms on the vagueness of the geographical name which

* Owen, 'Address to the British Association at Leeds,' p. 39.

† Falconer, Nat. Hist. Review, p. 60.

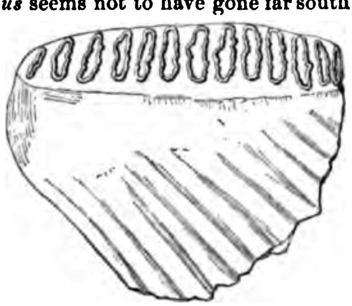
‡ *Loc. cit.* p. 52.

§ "Sur la dentition des proboscidiens fossiles, et sur la distribution géographique et stratigraphique de leurs débris en Europe." Bull. Geol. 1859, p. 469.

I proposed for the Texan elephant are, to a certain extent, neutralized by the fact that in his Synoptical Table, such "geographical names" are retained and put forth into circulation, as *Ohioticus*, Blum.; *Pyrenaicus*, Lartet; *Andium*, Cuvier; *Perimensis*, Falc.; *Arvernensis*, Croizet and Jobert; *Sivalensis*, Falc.; *meridionalis*, Nesti; *Africanus*, Blum.; *Hysudricus*, Falc.; *Indicus*, Linn.; *Armeniacus*, Falconer. It there appears that out of the twenty-eight species of *Elephas* and Mastodon known, at least eleven have names given founded on their regional habitats, for four of which names Dr. Falconer is individually responsible. In the same memoir in which he tells us "the distinctive characters of species are commonly founded on something more intrinsic and tangible," he actually proposes to add another "geographical name" to the list, to denote the pigmy elephant of Malta (*E. Melitensis*, Falconer).

Other original observers have alluded to the diversity of species in the American elephants. "It appears that the Mammoth (*E. primigenius*) ranged quite as far north in America as it did in Europe at one time, and indeed much further south (Sir Charles Lyell's 'Travels in North America,' vol. ii. p. 58), if the identification of its remains by the American geologists be a correct one, and there be no other species there corresponding to the *Elephas antiquus* or *priscus* of Europe."* In the 'Geologist' for April, 1861, a note appears, by Mr. G. E. Roberts, on the occurrence of a large elephantine beast in Texas, at the junction of the rivers Guadalupe and Comal.

In the recently-published geological text-book of Prof. Dana, it is stated:† "The American elephant ranged from Georgia, Texas, and Mexico on the south, to Canada on the north, and Oregon and California on the west. A tooth was found in ancient alluvium near the Colorado, 114½° W. and 35¾° N. (Newberry). Parts of one skeleton were dug up in Vermont, at Mount Holly, 1415 feet above tide level. The species appears to have been most abundant to the south, in the Mississippi valley, it preferring a warmer climate than that of *E. primigenius*. Fig. 837 [labelled *E. Americanus*] represents one of the teeth found in the state of Ohio. . . . The elephant in northern North America, in the British possessions, is supposed to have been the Siberian species." Dana states elsewhere,‡ that the *Elephas primigenius* seems not to have gone far south of the parallel of 40°. Dana's figure is copied from a manuscript Palæontological Report of Warren's Expedition to the Upper Missouri, by Meek and Hayden. The tooth exhibits twelve, or perhaps thirteen, enamel disks, of which the sixth and seventh show evident traces of the "*expansion médiane*" on which Dr. Falconer lays so much stress. I am, however, very doubtful to what species this can be referred. Lartet has already told us:—"Les dernières publications de M. le professeur Leidy, de Philadelphie, viennent de nous révéler l'existence dans l'Amérique du nord d'une faune pliocène, où figurent une nouvelle espèce de mastodonte (*M. mirificus*) et un très-grand éléphant (*E. impe-*



Elephas Americanus. From Dana's 'Manual of Geology.'

* Jukes, 'Student's Manual of Geology,' 2nd ed., 8vo, Edinburgh, 1862.
† Dana, 'Manual of Geology,' 8vo, Philadelphia, 1863, p. 562.
‡ *Loc. cit.* p. 560.

rator). Trois autres proboscidiens ont vécu dans l'Amérique du nord pendant la période post-pliocène ou quaternaire; ce sont l'*Elephas Americanus*, que M. Leidy considère comme étant distinct de l'*E. primigenius*, l'*E. Columbi*, Falc., des Etats du Sud et du Mexique, et le *Mastodon Ohioticus*, que quelques auteurs supposent avoir été contemporain des premiers hommes qui se sont établis dans cette région du globe." Whilst, however, I decline to offer any opinion whether the tooth figured by Meek may be referable to the *E. imperator* of Leidy, from Niobrara, I copy Dana's woodcut in the margin.

I have previously and frequently expressed the utmost deference to the palæontological authority of Dr. Falconer, whose constant study of the fossil specimens, thorough knowledge of the habits and food of the existing Indian elephant, and exhaustive acquaintance with proboscidean bibliography, must command respect amongst comparative anatomists. The foregoing remarks have, however, been called for to re-assert my title to be the first who directed attention to the "Bollaert molar," and to claim the undoubted privilege of every scientific man to describe any species of which no full, complete, and accurate definition has been previously promulgated.

Yours truly,

C. CARTER BLAKE.

Obituary Notice.

LUCAS BARRETT, F.G.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF THE BRITISH WEST INDIES.

THE last West India mail brought letters and papers announcing the premature loss of this amiable and accomplished naturalist, so lately among us taking an active part in the proceedings of the British Association at Cambridge.

He left England on the 17th of October last, and returned to Jamaica, accompanied by Mr. W. P. Colchester, eldest son of the gentleman who has for some years been the contractor for all the fossil phosphates of the Crag district and Cambridgeshire. He had formerly made a few very promising dredgings on the coast, at considerable depths; and being anxious to explore those portions of the sea-bed (between low-water and the limit of coral—perhaps about 15 fathoms) which are inaccessible to the dredge, he took out with him a diver's dress and pumping apparatus of the most approved construction, such as Mr. Heinke has supplied to all the stations of the Peninsular and Oriental Company, and which has been so successfully employed in recovering the wrecks of the 'Malabar,' 'Colombo,' and 'Royal Charter.' Dr. Bowerbank, of Kingston, writes word that he met Mr. Barrett on the 18th December last, in the House of Assembly, where he had gone to give evidence before a committee. He then told Dr. B. that he had been down the day before (in his diving-dress) in shallow water, and had succeeded well, and intended trying deeper water for the purpose of examining the coral reefs. Dr. Bowerbank begged him to wait till he could go with him; but he replied that "he would see." Other friends also warned him not to go, and offered to accompany him if he would defer it for a day; but he went, attended only by the boat's crew of negroes and his (negro) servants. Mr. Colchester happened to be away at the time, at the Pedro Keys. He says that "according to the evidence given by the men, Mr. Barrett went direct down from the boat into deep water by means of a rope-ladder. The pumps were worked uninterruptedly, as on the former occasion; but they noticed that he remained below longer than previously (which, according to his own statement, had been half an hour), and suddenly, to their horror, they observed his body floating at the surface of the water, a little distance from the boat. They got to him as quickly as possible, without ceasing pumping (so they declare), and on the removal of the helmet found him apparently dead. Without knowing in the least what to do, they took him on shore—some distance; but, of course, it was all over then, if it had not been long before." The verdict, at the inquest, made it appear that water had got into the air-tube at the joint, which was not screwed up tight enough; but this Mr. Colchester (and also Mr. Heinke) regarded as impossible. No water seems to have been found in the dress; and the rising to the surface, with all the weights upon him, could only have occurred by the valves for the escape of the air being closed. There is a small escape-valve in the helmet which is closed by a spring, and does not act until the pressure of the air is more than sufficient to cause the diver to rise. The principal valve is in the breast of the dress, and is closed by a lever, requiring the action of the hand. Now it appears that Mr. Barrett had neglected the precaution (which is always made imperative) of attaching the life-line to his body, preferring, he said, to hold it in his hand. If by any chance he lost this rope, he would lose his means of communicating with the crew, and become entirely dependent on the air-tube. His only means of rising to the surface would be by closing the escape-valve, which he must have done for this purpose, perhaps, on finding that something had gone wrong. All the inquiries hitherto made have left a painful doubt, which time will scarcely remove.

It has appeared desirable to give these particulars, because it looks like an instance of self-reliance carried too far, and a valuable life sacrificed, apparently, by the neglect of those precautions which any one less daring would have observed. The divers professionally employed work four hours at a spell, often inside the hulls of vessels; they are said even to have gone to sleep below! The only casualties have been one or two apoplectic seizures, which have occurred to men in government works, who probably were not fitted for the occupation.

Lucas Barrett was born in London, November 14, 1837. He was the eldest son of Mr. George Barrett, the iron-founder, whose works at the Record-Office and King's Cross Terminus are well known. He was sent, in 1847, to Mr. Ashton's school, at Royston, Cambridge, and afterwards to University College School, and in his holidays used to visit the British Museum, where he soon became known to the Natural History officers, by bringing fossils to be named, and volunteering to assist in unpacking and sorting collections. In 1853, he went to Ebersdorf, near Lobenstein, Voigtland, where he remained a year studying German and chemistry; and making, in the course of it, a pedestrian tour in Bavaria, which deserves to be recorded, as having cost him only one shilling a day. In 1855, he accompanied Mr. M'Andrew in a yachting voyage to Norway and Finmark, and made some observations on the living *Terebratulæ*, which were published in the Ann. Nat. Hist., and translated into the scientific journals of France and Germany. The same year he was chosen successor to Mr. M'Coy, as Curator of the Cambridge University Museum, and was elected a Fellow of the Geological Society of London, although perhaps legally ineligible, being only eighteen years of age. In the following year he obtained leave of absence, and accompanied Mr. J. W. Tayler to Greenland,—an expedition attended with considerable expense and no small amount of hardship, of which no account has been published; but there is a suite of specimens of shells, etc., collected by him, in the British Museum. In 1857, he again accompanied Mr. M'Andrew in a voyage to Vigo (the last cruise of the 'Naiad'), and added extensively to his collection of *Echinodermata*. Still, nothing was published except a short communication (by himself and Mr. Woodward), in the Proceedings of the Zoological Society, on the genera *Synapta* and *Cheirodota*.

During his custody of the Cambridge Geological Museum, many considerable additions were made and arranged by Mr. Barrett: such as the Saurians from the Lias, presented by Mr. T. Hawkins; the beautiful collection of Chalk fossils bequeathed by Dr. Forbes Young; and the local collection of the Rev. T. Image. The rapid and extensive development of the use of fossil phosphates from the Upper Greensand around Cambridge, supplied him with a new field of research; and early in 1858 he had detected two bird-bones, and numerous remains of several distinct species of Pterodactyle (some of extraordinary size), which have been figured and described by Professor Owen in the Transactions of the Palæontographical Society. He had also prepared a geological map of the vicinity of Cambridge, of which a second edition was published (by Macmillan) in the last year.

In 1859, he was appointed by Sir H. Bulwer to the important post of Director of the Geological Survey of the British West Indies, chiefly, it is understood, upon the recommendation of Professor Phillips. The salary and allowance for expenses, £700 a year, was raised to £800 soon after he had commenced his duties; and the sphere of occupation opened to him was every way worthy of his versatile and enterprising genius. The number of the 'Geologist' for last October contains a figure and description of a marvellous fossil discovered by him in Jamaica, and named after him, very much against his wish.

But although so well occupied in Jamaica, he must have retained a strong regard for Cambridge, where so much of his young life was passed. He had frequently lectured for Professor Sedgwick, and was such a favourite, that had he been a little older, and a graduate of the University, he would have been regarded as the probable successor to the Geological Chair. Some time before leaving England he was persuaded to enter Trinity College; and last year, when he came over as Commissioner for Jamaica to the International Exhibition, he resided and kept his Terms at Cambridge.

Of all the younger naturalists of the day he approached most nearly to Professor E. Forbes, in the sweetness of his disposition, his instinctive good taste, and the brightness of his intelligence; inferior, however, to Forbes in two respects, inasmuch as he never showed an aptitude for public speaking or writing. It may have existed in him, and would possibly have developed itself, had his life been spared. As it is, he served but for a little space to hold the lamp of science committed to him by some who trusted that he would long continue to hand onward that glorious light when they should have passed away. S. P. W.

FOREIGN INTELLIGENCE.

The topographical survey of Spain, under M. Coello, the accomplished geographer, is making progress. The triangles of the first order have been made for the whole kingdom, and those of the second order have been completed for the province of Madrid. The maps are on the scale of $\frac{1}{1000}$ for the country, and $\frac{1}{500}$ for cities. The geological department has completed its work in the provinces of Burgos, Santander, and Madrid; and those of Leon, Zamora, and Avita, are in progress.

The Transactions of the American Philosophical Society, vol. xii. (parts i. and ii.), contains the "Geology and Natural History of the Upper Missouri," with a map, by Dr. F. V. Hayden. In the 'Journal of the Philadelphia Academy' (vol. v., part ii., October, 1862) there is a "Monograph of the Fossil Polyzoa of the Secondary and Tertiary Formations of North America," by Mr. Gabb and Dr. Horn, with beautiful lithographic plates by Ibbotson; and an article on the "New Unionidæ of the United States and Arctic America," by Mr. Isaac Lea. The number of species described or known to exist were stated by Mr. Lea, in 1860, as,—*Unio* 465, *Margaritacea* 26, *Anodonta* 59,=550; to which he added, as not described, 30 in his own cabinet, 36 from North America, Mexico, Honduras, and Central America, and 1 from Canada; in all 617. Since then he has produced the above, and a previous paper containing further additions.

Professor Dana's 'Manual of Geology' has appeared (Trübner, 1863, 8vo, pp. 812). It treats the science with special reference to American Geological History, for the use of colleges and schools of science. The work is divided into four parts:—I. Physiographic; II. Lithological; III. Historical; and IV. Dynamical Geology.

The 'Canadian Naturalist' for October contains a letter "On the Cattskill Group of New York," by Professor James Hall. Late investigations, he says, have forced upon him the conviction that the greater part of the area coloured on the Geological Map of New York as Cattskill Group is in reality occupied by the Portage and Chemung Groups. Several years since, in making sections across the country from north to south, and through the counties of Albany and Schoharie, he ascertained that the Hamilton Group, as indicated by its well-marked and characteristic fossils, extends to the southern limit of the colouring indicating the Chemung Group on the Geological Map. He is prepared to show now that the Hamilton Group in the counties of Albany, Greene, Schoharie, Otsego, and a part of Chenango, with the exception of some outlines on the higher hills, occupies nearly the entire belt coloured as Chemung, the southern line corresponding very nearly with the limit assigned to that formation; thus leaving the Chemung Group, with its southern limits, still unassigned. Until within a few years, the State collection had been nearly destitute of fossils from the rocks of Delaware county, according to the map, Cattskill Group. Some time since, Professor Orton, of the Normal School, Albany, sent specimens which were recognized as characteristic of the Chemung Group; but as it was possible they might have been derived from transported masses, no decision was come to. More recently, Mr. J. M. Way, of Franklin, Delaware county, has found fish-remains in considerable abundance; from loose and scattered masses he has traced the specimens to their position in the hill-slopes, and has ascertained the existence of no less than three distinct beds containing these ichthyic remains. Associated with these, he has found numerous shells typical of the Chemung Group. Professor Hall describes these strata and their contents in detail.

There is also a letter by Colonel E. Jewett on the same subject.

Mr. Roff, C.E., of Montreal, read before the Natural History Society, in November, a paper "On the Superficial Deposits of Canada." On this subject Dr. Dawson, in Lower Canada, has made many valuable contributions; and in the Upper Province, Professor Chapman, of Toronto, and Mr.

Robert Bell, under the direction of Sir Wm. Logan, have thrown much light upon the subject. These three accomplished observers are agreed in dividing the superficial deposits, or drift, of Canada, into an upper and a lower member; the former consisting of dark blue and greyish clays, the débris of the underlying limestone, and nearly destitute of boulders; the latter of sand and gravel of granitic or gneissoid origin, with numerous boulders. Throughout Lower Canada, and as far west as Kingston, the relative age of this deposit has been determined by appropriate fossils of recent or existing species; and although these are wanting in the Upper Province, the analogy is presumed to be established by other characteristic features.

The fact to which the author specially draws attention is, that the older formation prevails almost exclusively in western Canada on the elevated platform bounded on the north and east by the Niagara escarpment, which sweeps round in a bold and abrupt manner from the Niagara, the head of Lake Ontario, and northward to Cabot's Head, on Lake Huron, forming a very marked feature in the physical geography of the province. The whole of the country for a great distance to the east, by this line, and especially towards the base of the escarpment, is thickly strewn with sand, gravel, and boulders of Laurentian origin; while to the west these are of very rare occurrence, and are replaced by materials evidently derived from the disintegration of the underlying limestone. From the Niagara escarpment westward to the height of land near Woodstock, this difference is less marked than from that point still further west to the shores of Lake Huron. The inference to be drawn from these facts, Mr. Roff thinks, confirms the opinion of Lyell and others who have examined the physical geography of Canada, that the contour of the fundamental rocks of the country was impressed at an epoch long anterior to the glacial or drift period, and that the elevated platform of the western peninsula, if not actually above the level of the sea at that period, was sufficiently high to resist the intrusion of ice-islands charged with the débris of the Laurentian and other ancient northern rocks which would be drifted by the glacial currents from the north-east.

NOTES AND QUERIES.

Didymodon Vaucluseanum.—[The following note was accidentally left out of Mr. Blake's paper in last month's 'Geologist.'] I have been led to consider the last tooth in the jaw as the third molar, by reason of the shape of the impression indicating the insertion of the pterygoid muscle immediately beneath it, rendering it very improbable that any tooth can have existed behind it in the jaw. C. C. Blake.

Kitchen-Middens of New Zealand.—Mr. Lubbock has, in an able and interesting memoir in a late number of the 'Natural History Review,' described a series of shell-deposits in Denmark termed "Kjökkenmöddings," or kitchen-middens, being the heaps of waste shells and other débris thrown aside after their feasts by the ancient human inhabitants of the country.* It may not be uninteresting to know that deposits similar to the "Kjökkenmöddings" are still in course of formation, though not perhaps in Europe. In New Zealand, large heaps of shells, often six or eight feet in thickness, are common near the shore. These are most frequently met

* 'Natural History Review,' vol. i., 1861, p. 489.

with near native villages, but it is by no means uncommon to find them far from any trace of Maori dwellings. I have never seen any human bones in these, though from the former cannibal habits of the aborigines of New Zealand, it might be anticipated that some human remains would be found, and indeed on closer examination such may be discovered.

These kitchen-heaps are composed chiefly of the shells of one species of bivalve mollusk, called by the natives *pipi*, which is still plentifully taken and eaten, though not so much so as before the European occupation of the country. The natives now have a better supply of animal food than formerly, in the pigs, poultry, and oxen introduced by the Europeans, and are not so dependent on the produce of the sea and rivers.

This note may perhaps serve as a hint to some future traveller to examine more attentively than I did the shell-heaps formed of the débris of Maori feasts. Useful comparisons may thus possibly be elicited between these remains and the Kjökkenmöddings of Denmark, and those found at the Pileworks of Switzerland. R. LECHMERE GUPPY.

Trinidad, 29th November, 1862.

NEWFOUNDLAND.—The 'Canadian Naturalist and Geologist' for October contains "Observations on the Geology and Physical Characteristics of Newfoundland," by the late President of the Natural History Society of New Brunswick, M. H. Perley, Esq. The paper first gives a description of the physical features of the island, and then reviews the former labours of Mr. Jukes, adding to the statements of what was accomplished by him the subsequent observations of the author himself.

Gypsum is abundant at Cadroy, and a splendid white marble on the Humber. Ores of copper have been found in several districts, and explorations have been carried on by various parties, whose discoveries have not yet been made public. An extensive deposit of lead has been found at La Manche, in Placentia Bay, and worked for a short time by an American company.

JAWS WITH TEETH IN THE ARCHÆOPTERYX SLAB.—In the counterpart slab of the Archæopteryx is a portion of bone with four or five teeth, which has caused some little excitement, under the idea that it might be the jaw of that bird. Mr. Davies considers it the upper part of the head of a lepidoid fish (maxillary bone), an opinion in which we are disposed to concur, but at present we wish only to notice the fact, not having been able to fully examine the case in time for publication in this number. We would suggest a fair comparison of these teeth and portion of jaw with the corresponding parts in the various species of Pholidophorus and Lepidotus, and we should be glad of the loan of good specimens for the purpose—the specimens in the National Collection not being sufficiently perfect, as respects the head, for this special examination.

SCOTCH CROCODILES.—The following announcement appears in a contemporary :—"A rumour, of which confirmation is promised, has reached us, that the skeleton of a crocodile has been discovered in the old red sandstone in the neighbourhood of Elgin. If true, it marks another epoch in geological science, as the fossil remains hitherto found in that formation have been of creatures much lower in the scale of organization." We thought that the white sandstone near Elgin, long erroneously regarded as of Devonian age, had been proved to be Mesozoic, and that reptiles apparently of some crocodilian affinities (*Stegonolepis*) had already been discovered therein. The assertion that the present rumour "marks another epoch in geological science" seems to us one of those premature deductions which have been elsewhere stigmatized as "the fabulous excrescences of a credulous and gossiping zoology."

Subdivisions of British Rocks.—We find space for the following list of the subdivisions of British rocks, as recognized by the Geological Survey, believing it will prove useful to many of our readers.

Blown sand.		
Alluvium.		
Peat.		
Raised beaches.		Post-Tertiary and recent.
Cave-deposits.		
Valley, or low-level gravel.		
Brick-earth.		
High-level gravel.		Newer Pliocene.
Glacial drift.		
Till and boulder clay.		
Cave-deposits.		Older Pliocene.
Mammaliferous (Norwich) crag.		
Red crag.		
Coralline crag.		
Leaf bed of Mull.		Miocene.
Lignite of Antrim.		
Bovey beds.		
Hempstead beds (Isle of Wight).	Fluvio-marine.	Upper Eocene.
Bembridge beds.		
Osborne beds.		Middle Eocene.
Headen beds.		
Upper Bagshot sands.		
Barton clay.	Middle Bagshot.	
Bracklesham sands and clays.		
Lower Bagshot sands and clays.		
London clay.		Lower Eocene.
Bognor beds.		
Woolwich and Reading beds (plastic clay, with sand, pebble-beds, etc.).		
Thanet sands.		
Upper chalk.		Upper Cretaceous.
Lower chalk.		
Chalk marl.		
Chloritic marl.		
Upper greensand.		
Gault.		
Folkestone beds.	Lower Greensand.	Lower Cretaceous.
Sandgate beds.		
Hythe beds, or Kentish rag.		
Atherfield clay.		
Weald clay.		
Upper Tunbridge Wells sand.	Hastings Sand.	
Grinstead clay.		
Lower Tunbridge Wells sand.		
Wadhurst clay.		
Ashdown sands.		
Ashburnham beds.		

Upper Purbeck beds.	Purbeck beds.	Upper Oolite.
Middle Purbeck beds.		
Lower Purbeck beds.		
Portland stone.	Portland beds.	
Portland sands.		
Kimmeridge clay.		
Upper Calcareous grit.	Coralline Oolite.	Middle Oolite.
Coral rag.		
Lower Calcareous grit.		
Oxford clay and Kelloways rock.	Oxford Clay.	
Cornbrash.	Forest Marble.	Lower Oolite.
Forest marble.		
Bradford clay.		
Great, or Bath Oolite.	Great Oolite.	
Stonesfield slate.		
Collyweston slate.		
Northampton sands.		
Upper Fuller's earth.	Fuller's earth.	
Fuller's earth-rock.		
Lower Fuller's earth.		
Inferior Oolite.		
Lias junction-sands.	Lias.	
Upper Lias clay, or shale.		
Marlstone.		
Lower Lias clay, shale, and limestone.		
Westbury beds (or white limestone).	Koessen beds.	Trias.
Bone-bed.		
Red marl and	Keuper.	
Upper Keuper sandstone.		
Lower Keuper sandstone.		
Marl (waterstones).		
Muschelkalk, absent in Britain.		
St. Cassian beds.		
Dolomitic conglomerate (Somerset and Gloucestershire).		
Upper red and mottled sandstone.	Bunter.	
Pebble beds.		
Lower red and mottled sandstone.		
Upper red marl.	Zechstein.	Permian.
Upper magnesian limestone.		
Lower red marl.		
Lower magnesian limestone.		
Red marl, sandstone.	Rothliegende.	
Breccia and		
Conglomerate.		

·measures. l-measures. it. -measures. beds. rit (farewell rk.)	Coal-measures.	Upper Carboniferous.
ıestone shale e rocks). ɔus (or moun- .estone. stone shale.	Carboniferous Limestone.	Lower Carboniferous.
onian and in limestone. vonian lime- d cornstones. onian.	Devonian.	Old Red Sandstone.
low. limestone. llow.	Ludlow beds.	Upper Silurian.
imestone. ıale, sandstone s. limestone. ire grits, lates, and	Wenlock beds.	
shale (or pale ındovery rock ill sandstones) ıerus beds).	Llandovery.	

Lower Llandovery rock. Caradoc or Bala beds.		Lower Silurian.
Upper Llandeilo flags and limestones. Tremadoc slates.	Llandeilo group.	
Lingula beds.		
Harlech grits, etc. Purple slates and grits (St. David's). Llanberis grits and slates. Longmynd rocks. Red sandstone, conglomerate of Scotland.	Cambrian.	Cambrian.
Gneiss of the Lewis		Laurentian.
Basalt. Hornblende rock. Porphyry. Felstone. Trappean rock (Devon and Cornwall). Diallage. Hypersthene rocks. Serpentine. Elvan dykes. Greenstone (Diorite). Ashy slate, and Felspathic ash. Syenite. Granite.		Rocks in masses, chiefly crystalline and eruptive.

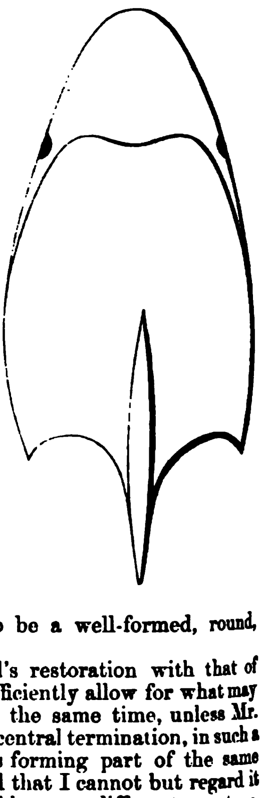
SCOTCH SYSTEM OF CARBONIFEROUS ROCKS.

-measures =	Equivalent to British middle coal-measures, Pennant grit, lower coal-measures.	Upper limestones Edge-coals series Lower limestones =	Upper limestone shale (Yoredale rocks), Carboniferous limestone.
=	Millstone grit (Farewell rock).	Sandstones, shales, and Burdie House limestone	Lower limestone shale.

ON PTERASPIS.—Sir,—I hope you will allow the following re- ccasioned by the notices of Pteraspis in the 'Geologist' for No- December, and January last, a place in an early number.

spring of 1861, from amongst a lot of fragments laid aside by the ı in a quarry in the hill immediately to the north of the Bridge of picked up a fine head of *Cephalaspis Lyelli* and two tolerably heads of Pteraspis; and since that time I have, from the same ocured another less perfect specimen of the latter genus. To this r I referred in a paper read to the Geological Society of London of the same year; and thus, I believe, I was the first to show that tish rocks containing Cephalaspis also possessed the nearly allied :eraspis.

most perfect of these three heads, both the cast and its opposite have been saved, and are now in my possession. Although the matrix in which they have been preserved is so very coarse that the various layers composing the cephalic shield are not sufficiently preserved to show their characteristic structure, and hence Professor Huxley failed to identify my specimens with any of the named English species, yet its form is very perfectly exhibited; and in the cast, the spine which proceeded from the posterior part of the head is well shown. The rough sketch I herewith give is a tolerably correct representation, and is of the size of nature; from this it will be seen that it much more nearly coincides with Professor Huxley's restoration than with that of Mr. Mitchell. The head-plate had evidently been formed of two parts, the anterior resembling in shape the head of a small Cephalaspis, but rather more elongated; the posterior portion is by much the larger of the two, its length being nearly two and a half times that of the anterior; its shape is nearly oval, truncated behind, with a short cusp or horn on each side, and in the centre stretching backwards and upwards, terminating in a sharply pointed spike or spine. A very distinctly incurved ridge, but of no great elevation, commences about halfway back on the posterior plate, and terminates in the above-mentioned spine. There are indications at the edges of the head, very close to the junction of the two plates, of what may have been the eye orbits, but these are indistinct. The principal if not the only points of divergence betwixt the specimen and Professor Huxley's restoration are, the position of the lateral terminal cusps, and the absence of any division betwixt these and the head-plate, and in the form and size of the posterior elongation (nuchal spine), which in my specimen seems to be a well-formed, round, sharply pointed spine.



Mr. Lankester, in comparing Mr. Mitchell's restoration with that of Professor Huxley, does not, in my opinion, sufficiently allow for what may have been specific differences of form; but at the same time, unless Mr. Mitchell finds what he figures as the prolonged central termination, in such a position as to afford undoubted evidence of its forming part of the same head, its size seems to me so sadly exaggerated that I cannot but regard it as having formed part of some other, probably very different creature. What renders this the more likely is, that I have examined many fragments which, although too imperfect to found on for any new genus, seem to belong to some nearly allied form, and are evidently parts of neither Cephalaspis nor Pteraspis. I am also much inclined to suspect that Mr. Mitchell's third figure has been built up of such fragments. Several heads of Cephalaspis which have been in my hands, go far to show that the larger part of the under portion of this fish's head had been covered by integument; and judging from the many points in which Cephalaspis resembles the Sturgeon of our own seas, I have little doubt but that, like it, it was furnished with a sucking apparatus for its mouth; and in all probability the under portion of the head of Pteraspis was similarly formed.

'rom these remarks, it must not be supposed that I wish, in any way, etract from Mr. Mitchell's merits as an observer,—he is one of the t indefatigable as well as intelligent workers in that interesting field, Forfarshire Old Red Sandstone; besides, not having seen his speci-1s, it would be unfair to speak too decidedly as to the correctness of restorations. Mr. Mitchell has omitted to mention the locality from ence his specimens have been procured, so that the position of the con-ting rock might be ascertained. I have, however, little doubt but that occupies the same horizon as that at Bridge of Allan, and that hence Pteraspis is, in all probability, specifically the same as those in my pos-sion. JAMES POWRIE.

Reswallie, January 23rd, 1863.

EAST COAST OF CHINA.—The geology of this region was described by :. F. W. Kingsmill, in a paper read before the Geological Society of ıblin during the past year, and is printed in the last number of the 'ublin Quarterly Journal.' Commencing with the igneous rocks, there etches, from the neighbourhood of the island of Hainan, N.N.E., to the ıusan Archipelago, a range of low granite mountains, from a few hun-ed to three thousand feet high, and in breadth from twelve to thirty les. These hills form, for the most part, the coast-line, seldom receding re than a few miles inland. This granite, wherever it occurs, is deeply integrated, sometimes to a depth of one or two hundred feet; whilst erywhere embedded in the soft, yielding matrix, there occur nodules of re quartzose character, which have resisted the effects of time and che-cal change. The masses are usually of a lozenge shape, and vary in e from a few feet to several hundred. The original quartz veins, broken o fragments, still traverse the disintegrated mass; whilst in the enclosed dules concentric structure can generally be traced. In the higher ounds, the soft, yielding matrix has generally been removed by denuda-n, leaving those pseudo-boulders perched all over the granite hills, and esenting an aspect not unlike the boulder-formations of more northern itudes. These have led, the author says, to an error in Professor An-d's 'Elementary Treatise'—namely, that the southern limit of the acial drift reached as far as Macao.

In the Quan-si, west of Canton, a gneissose rock is described. Resting the granite occurs a stratified formation, most likely of Silurian age. may be seen to advantage in the island of Hongkong. Over this is und a red sandstone, in some parts running into conglomerate. At the trance to the West River (See-kiang) there is a dark, fine-grained, alu-inous schist, much used for ink-stones and carved work. Over this red ndstone is the great limestone formation of China—the representative, obably, of the carboniferous limestone. In Quan-si it contains veins of aphite. Near Peking, at Lu-sud-twang, occurs a bluish-yellow slate, of fissile a character as to be used for covering houses. The coal-mea-ıres succeed the limestone, the lowest member being apparently a micaceous ndstone, interstratified, near Peking, with compact ironstone and beds of onstone. The coal-beds there are spoken of as overlaid by compact mestone. In the province of Chu-kiang a coal district also occurs, the easures probably being continuous; in this case, the Chinese coal-fields ay prove to be the largest in the world, and at a future period will have n important influence on the destinies of the East.

The author knew of no formations of later date than the coal-measures, ith the exception of the alluvial deposits in the great plains and perhaps me Secondary rocks in the island of Hainan. These plains occupy the reater part of China, and are everywhere intersected with canals and dykes, and seldom rise to more than a few feet over the medium level. From the mouths of the Yang-tze to the walls of Peking, along the Grand Canal, there scarcely occurs a rising ground, and the soil is so soft and muddy that it has been all but impossible to form a carriage-road in the British settlement of Shanghai.

In a general view of the geology of China, the country would appear to be divided into two districts, one consisting of the provinces of Quantung, Quang-si, and the southern portions of Yunnan, the other of the northern portions of Yunnan and the provinces lying northwards. They appear to be divided by the range of mountains running W. and E. through Yunnan, and terminating eastward in the Me-ling range, across which the road from Canton to Hankow passes at a considerable elevation. South of this line the rocks appear to be more of the metamorphic character, and to contain little if any coal, whilst to the north they are much less altered, and contain abundant stores of mineral fuel.

Erratum.—In the editor's article on Archæopteryx, p. 6, for "Miocene Rocks of Bonn, as well as in Braunkohl, near Aix," read "Miocene rock near Aix, as well as in the Braunkohl of Bonn."

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Geological Society.—*January 7th.*—"On the Lower Carboniferous Brachiopoda of Nova Scotia." By T. Davidson, Esq., F.R.S., F.G.S.

The age of these beds was first clearly determined by Sir C. Lyell, and the author proceeded to point out the affinities of the entire Carboniferous formation to the Permian, and observed that many species, especially of Brachiopoda, are common to both formations. He combated the idea of a universal extinction of species at the close of the Palæozoic epoch, on the ground that some Palæozoic species pass upwards into Mesozoic strata; and then, after remarking upon the vagueness of the term 'species,' proceeded to show that science was not yet in a condition to enable us to test satisfactorily, by observation, the value of Mr. Darwin's theory of descent with modification. Mr. Davidson then remarked that the Lower Carboniferous Brachiopoda of Nova Scotia were smaller than the same or representative species occurring in contemporaneous strata in other parts of the world; and he concluded by giving diagnoses of the species determined by him, and comparing his list of species with that given by Sir C. Lyell in his 'Travels in North America.'

2. "On the Gravels and other superficial Deposits of Ludlow, Hereford, and Skipton." By T. Curley, Esq., C.E., F.G.S.

In describing some plans and sections taken during the progress of drainage-works in Ludlow, Hereford, and Skipton, the author mentioned the existence, near Ludlow, of two kinds of gravel, having a difference of level of about 100 feet, described three terraces of a like nature, about 30 or 40 feet apart vertically, in the vicinity of Hereford, and then noticed similar deposits near Skipton. Mr. Curley considers the majority of these gravel-beds to be of lacustrine origin.

Manchester Geological Society.—*November 26th.*—An account was given of the excursion to Halifax, Hipperholme, Lightcliffe, and Low Moor, on the 3rd of September, with the Geological Society of the West Riding of Yorkshire, by E. W. Binney, Esq., F.R.S., V.P. The Natural History Society's Museum, at Halifax, was visited. It contains the finest examples of *Goniatites*, *Nautilus*, *Orthoceras*, and *Aviculopecten*, from he Lower Coal-measures. These specimens were chiefly obtained from he calcareous nodules, known as "baum pots," found in the roof-shale of he "hard bed" of coal, which has been extensively worked in the neighourhood. There is also a good collection of fossil coal plants. Swan anks Colliery was next visited. The "soft" and "hard" beds are rought there. The former, 1 foot 5 inches thick, lies about 45 yards bove the "rough rock"—the Upper Millstone of Professor Phillips and ie Geological Survey. Twenty-six yards above the last-named seam is the hard bed," nearly 2 feet in thickness, with a thin Gannister floor, round alcareous nodules or bullions in the seam of coal itself, and black shales, ontaining the "baum pots," in the roof. The geological position, charac-ers of the coal and its adjoining strata, as well as the fossil shells, all tend show that this seam is the same as the bullion mine of the Burnley dis-ict, and the Gannister mine of Dulesgate, Todmorden. The lower mine, ontaining beds of *Anthracosia* under its floor, probably occupies the same eological position as the Bassy or Salts Mine of the Bury and New Mills istricts. Besides these two seams there are several smaller ones which re not worked; and on the top of the hill the lower part of the Elland lagstone, the equivalent of the Upper or Upholland flags of Lancashire, is een; so this series of coals lies between the rough rock and the upper lagstone, and is identical with that part of the lower called Rochdale series f coals in Lancashire.

Mr. Richardson's unrivalled collection of fossil plants from the York-hire coal-field was next inspected; then the flagstone quarries of Hipper-iolme and South Owram, where flags of 4 and 5 yards square were being ifted. These stones, under the name of Yorkshire flags, are known all ver England. The party now started by rail to Low Moor.

The Low Moor Iron Company's works were visited, as were also the mines. The lower, or "better bed," is a coal of most excellent quality, but only about 16 inches in thickness. It is exclusively used for making oke to smelt the iron-ore. The "black bed," from 30 to 35 inches in thickness, lies some 40 yards above it; but it is very inferior in quality: over it are about 4 inches of clay-band ironstone, in 4 or 5 layers, dispersed through 4 feet 6 inches of black shale. Besides the "black bed," an ironstone, known by the name of the "white bed," and lying some distance above the former, is used.

The position of the Low Moor seams of coal and their accompanying ironstones, is immediately above the Halifax series of coals and its over-lying bed of flagstone, as seen at South Owram; strata not well developed in the Lancashire coal-field, although there represented near Heywood, between the upper flag deposit and the Arley or Dogshaw Mine.

The composition of the ironstone differs little from the ordinary clay-ironstones of the Yorkshire and Derbyshire Coal-measures, certainly not so much as to account for the price and quality of the iron made from the former, when compared with that made from the latter; it is therefore evident that the chief cause is the superiority of the iron produced.

An opinion was expressed by members of both Societies that it was desirable more of such mutual meetings should be held. Meetings might be held at Settle, to examine the bone-caves; at Ingleton, to inspect the Permian deposits of West-house, the coal-field of Black Burton, the mountain limestone and Silurian beds of Thornton Gill, and the dykes of Chapel-le-Dale; at Hazelhead, to examine the Lower Coal-measures seen between Dunford Bridge and Penistone.

Mr. Joseph Goodwin read a paper "On the Long-wall *versus* Pillar-and-Stall System of getting Coals." Much has been said upon the relative merits of the two systems of working coal; but all must be agreed as to the importance of adopting the system that will admit of the greatest percentage of "round" or "hand-filled" coal, and the greatest yield per acre, whilst affording to the workman the greatest security from accident, and the capitalist from losing his property. To say that any one system possesses all these much-to-be-desired advantages, under all circumstances, is more than could be affirmed. That the long-wall system possesses advantages over the pillar-and-stall, under some circumstances, is an indisputable fact; while, on the other hand, it is simply impossible to work some mines to advantage upon the long-wall system, however skilfully the workings may be conducted. Perhaps the most important advantage in the long-wall system is, that all the coal may be worked out without the slightest waste; this cannot be said of any other. If we consider this loss or waste in a national point of view, it will not be of much less importance to the whole community or future generations than it is to the proprietors of mines who sustain a direct pecuniary loss; for although there may be no fear of the coal of the United Kingdom being exhausted for a couple of centuries, —and in the meantime substitutes may be discovered that will lessen its consumption, and render the nation much less dependent upon it than at present,—it, however, cannot have failed to have occurred to all who have carefully considered the subject, that before another century has passed over, coal will not only be far more difficult to work, owing to the increased depth at which it will have to be wrought, but that some of our existing coal-fields will have been worked out, and many others reduced to very narrow limits.

In working the coal upon a properly conducted system of long-wall working, where the mine is adapted for such system, there can be little doubt but that the risk of accidents from falls of roof is materially lessened. The author had never seen the slightest accident from such source, where the long-wall system has been practised. But the fact ought not to be overlooked that some mines are naturally more dangerous to work than others, and that the danger often increases in proportion as the thickness of the seam increases, assuming that all other circumstances remain the same, and that, as a rule, it is the thinnest seams that are worked upon the long-wall system. The ventilation is far more simple in long-wall working than in pillar-and-stall, besides which, the health of the workman is not so impaired by driving narrow or "strait" work, this being in a great measure dispensed with.

Another advantage for the long-wall system is that of being able to dispense with the necessarily large outlay consequent upon driving narrow work in a systematic manner preparatory to working back the pillars, and thus securing a return for the capital expended in the least possible time. The North of England may be considered as the parent of the pillar-and-stall system, but it is now more or less used in almost every coal-field in Great Britain as well as upon the Continent. If it possessed no advantages over the long-wall system, the mining engineers who adopt its use might reasonably be considered very prejudiced men. That epithet has been lavishly applied by some of the advocates of the long-wall system to those who continue the use of the pillar-and-stall system, forgetting that they lay themselves open to the very same charge by adhering too rigidly to that which they believe to be the best. The author had deemed it best to carefully examine into every circumstance connected with a mine before adopting any system, and after so doing, he would not say that he might not err in judgment. The pillar-and-stall system will admit of an almost unlimited quantity of coal being daily worked from the same that would only admit of a very limited output if the long-wall system used. With many this is an advantage that must weigh much in its ur; although he was not an advocate for raising very large quantities re a smaller quantity, with judicious management, would produce a er profit. With the pillar-and-stall system the workings may be coned any reasonable distance upon the line of level, the only limits being increased cost of conveying the coal to the pit's eye, and the difficulty horoughly ventilating the workings, owing to the increased drag or stance that has to be met in conveying currents of air through long courses.

7ith the long-wall system the case is very different; for owing to the culty and expense of keeping good the wagon- and air-roads, the dis-e is practically limited in many mines to a few hundred yards. The atest distance on the line of level known to be worked out upon the t-wall system is rather more than 800 yards.

Vhere there are numerous faults, it is difficult to work a mine to advan-; upon the pillar-and-stall system, but it is still more difficult upon the g-wall system; but the former system can be used under some circum-ices where it would almost be impossible to work upon the long-wall tem.

he quantity of timber that is used is not materially different whether coal be worked on the long-wall, or pillar-and-stall systems, providing ual skill is displayed in laying out the workings, etc. While the cost of ting depends so much upon circumstances that it is unsafe to hazard an nion in favour of either system, unless both have been employed in the ie mine, under very similar circumstances,—and even in cases where t course has been adopted—the results have been sometimes in favour the pillar-and-stall system, and at others *vice versâ*. It may be that asionally some other system will answer better than either of the sys-is under consideration, for we by no means embrace the whole of the tems of getting coal when we speak of the pillar-and-stall and long-ll, although many of the methods of working coal are but modifications either one or the other.

Mr. Binney said: "No doubt there will be more advocates for the pillar-l-stall system in Lancashire than for the long-wall. If the Lancashire itlemen went into North Derbyshire, probably they would find a great ny advocates of the long-wall system, and they would see advantages re which they do not see in Lancashire. The same remark will apply the East of Scotland. The different systems of long-wall and pillar-l-stall workings would have different advantages in particular districts. Derbyshire, where the long-wall system has been going on for 150 200 years, the men are so thoroughly drilled to it, and work it so scien-cally, that its results would hardly be fair as applied to Lancashire, where would take a long time to get men to work so well at it as they do in rbyshire. On the other hand, there would be a like difficulty in intro-cing the pillar-and-stall system into Derbyshire.

PHILOSOPHICAL SOCIETY, MANCHESTER.—*January* 13.—Mr. E. W. aney, the President, said:—In a very valuable work lately published by it eminent geologist Dr. Geinitz, of Dresden, entitled 'Dyas, or the ignesian Limestone Formation and the Lower New Red Sandstone,' the hor, whom he had the pleasure of accompanying over some of the Per-in deposits of South Lancashire, had done him the honour to allude to o papers of his, 'On the Permian Deposits of the North-west of Eng-id,' printed in vols. xii. and xiv., second series, of the Society's Me-irs.

At page 313 of the above work, Dr. Geinitz says: "Through Mr. Binney we have become acquainted with true Rothliegende, and indeed of its upper portion in the region of the Lower Red Sandstone of the north-west of England. That accurate observer mentioned to me that the reddish-grey sandstone underlying it, and which is very similar to the Lower Red Sandstone of the north-east of England, contains plants of the Coal-measures, and that it occupies even a lower position than certain limestones of the coal-measures which are rich in ichthyolites. I have myself seen from the reddish sandstone of Astley, near Manchester, *Calamites approximatus*, Schl., and *Calamites Suckowi*, Brongn.; from the red shales at Ardwick, Manchester, *Sagenaria dichotoma*, Sternb., *Calamites Suckowi*, Brong., *Sphenopteris irregularis*, Sternb., *Sphenopteris coralloides*, Gutb., *Dictyopteris neuropteroides*, Gutb., *Cyatheites villosus*, Brong., *Cyatheites oreopteroides*, Göpp., and *Alethopteris lonchitides*, Sternb., all true coal plants."

No one more than the learned author, Mr. Binney said he was sure, would like any mistake to be corrected. Now in the statement that "the reddish-grey sandstone underlying it (the true Rothliegende), and which is very similar to the Lower Red Sandstone of the north-east of England, contains plants of the coal-measures," the Doctor is quite correct; but when he proceeds to state "that it (the true Rothliegende) occupies even a lower position than certain limestones of the coal-measures which are rich in ichthyolites," that author had misunderstood him, and had apparently confounded the ribbon-beds of limestone in the red marls lying above the pebbly beds at Astley with the Upper Carboniferous limestones at Ardwick, and then stating that such pebble-beds occupy an inferior position to the latter. It is certain that the Astley pebble-beds containing coal plants occupy a higher geological position than the red shales, which, the Doctor truly states, also contain true coal plants. How much higher it is impossible to say, as it is most probable there are higher Carboniferous strata than those yet seen at Ardwick, and there may be Permian strata lower than those up to this time met with at Astley—at present we cannot tell.

As the Permian group of strata is now occupying the attention of geologists both in England and on the Continent, the following table of the beds in the north-west of England, with their approximate thicknesses, as seen at Shawk, west of Carlisle, Westhouse, south of Kirkby Lonsdale, and Manchester, in the descending order, may be acceptable:—

	Shawk.	Westhouse.	Manchester.
	Feet.	Feet.	Feet.
1.*Laminated and fine-grained red sandstones.	300	Not seen.	Not seen.
2. Red and variegated marls, containing sometimes, but not always, beds of limestone and gypsum, with fossil shells of the genera *Schizodus*, *Bakevellia*, etc.	150	Traces of them seen.	300
3. Conglomerate	4	300	50
4. Lower New Red Sandstone, generally soft and incoherent	7	500	500
5. Red shaly clays	Not seen.	250	Not seen.
6. Astley pebble-beds, containing common coal plants, termed by me Lower Permian	Not seen.	Not seen.	60

* The first four strata of the above series, Professor Harkness, F.R.S., in a fine natural section seen at Hilton Beck, north of Brough, estimates to be of 3000 feet in thickness.

n reference to the age of the New South Wales coal-field, Mr. Edward l stated that he had received letters from the Rev. W. B. Clarke, who for many years been engaged in its exploration, and from Mr. John ckenzie, who has had considerable experience as a mining surveyor in gan and North Wales. It is well known that Mr. Clarke maintains Palæozoic age of the carbonaceous deposits of New South Wales, in osition to Professor M'Coy, who holds that they are of more recent nation (Mesozoic). As Professor M'Coy has never actually visited the w South Wales coal-field, and derives his information from cabinet spe- iens, men of science will probably prefer the evidence of one who has nt years in personally exploring and collecting from the beds them- res. In Mr. Clarke's memoir on the 'Recent Geological Discoveries in stralasia' (2nd edit.), the author defends his view of the Palæozoic age the coal-bearing strata; and in the letter from Mr. Mackenzie, the iter gives the following series of fossiliferous strata *overlying* the coal l cannel belonging to the Hon. B. Russell, which, if correct (as there is ery reason for supposing), ought to set the question at rest in favour of true Carboniferous age of those coal-measures. He states, "In a pit ove this coal are strata with *Fenestella*, *Stenopora*, *Orthonota costata*, *irifer*, *Producta*, *Terebratula*, etc. In a pit about 100 feet below the me coal, occur *Spirifer*, *Producta*, *Conularia*, and vegetable impres- ns; about 60 feet lower, *Spirifer*, *Terebratula*, *Pleurotomaria*, and *enoptera*; and similar shells, accompanied by vegetable remains, are ated to occur still lower." Mr. Mackenzie promises to send specimens of *epidodendron* and *Sigillaria* from the same beds.

REVIEWS.

Journal of Botany. London: Hardwicke. Feb. 1863.

It has been a matter of astonishment to us, that the science of Bo- any has had no Journal in this country for several years. At a time hen Hooker's Journal had got thoroughly established, it was suddenly iscontinued, in the belief that the Quarterly Proceedings of the Linnean ociety would supply all that was needed, but these, although every way uited for the publication of members' papers, could never afford a medium f intercommunication amongst botanists throughout the country, and bo- anical papers that did not find their way to a learned society were either uried among zoological and other memoirs, or hid in agricultural or orticultural periodicals, where no botanist would expect to find them. It is then satisfactory to hear that simultaneously with our present num- ber, a new 'Journal of Botany, British and Foreign,' will begin its life under the editorship of Dr. B. Seemann, F.L.S., F.G.S., etc., whose 'Bo- tany of the Herald' and numerous systematic Papers have given him an eminent place among botanists, and whose 'Viti and the Vitians' has re- cently established him as a popular and entertaining writer. He is assisted by several eminent botanists, both at home and abroad. Surely, an un- dertaking that promises to be of such service to botany will meet with the speedy support of all lovers of a science so extensively studied and so de- servedly popular.

We are gratified in hearing that the successful establishment of the Geologist' has been regarded as an encouragement for the present attempt to establish a similar valuable means of intercommunication amongst the members of one of the most extensively studied of our sister-sciences. We hope it will do well.

Rambles in Search of Wild Flowers. By Margaret Plues. London. 1863.

Spring-time is coming; the tender buds are already showing their first green tops; and soon the buttercups and primroses, on meadow and on road-bank, will catch the brighter sunshine and bind its rays in golden flowers. Truly the geologist may feel rejoicingly the coming return of Spring's verdant scenes, for is he not a naturalist of the present as well as of the past? In those "sweet flowers,"—sun-smiles caught and bound to earth,—"the oak-tree and the mountain pine" are lessons of to-day for him by which to read the great eventful past to which his mind incessantly reverts. "This world is full of beauty, like other worlds above;" and in the silent rocks, at least for him, are records of perished earthly scenes, grander if not as fair as those spread out around.

> "Gather the Roses while you may;
> Old Time is still a-flying;
> And this same flower, which smiles to-day,
> To-morrow will be dying."

Amongst the dead leaves that fell in the primæval forests of our old earth ages before the merry laugh of the maiden Eve was echoed by the warbling birds in Paradise, Nature had caught, and in her stony tomb had kept, some few faded flowers. Was it to tell us, who were to live in after-times, that the fields the great beasts tenanted, and whom we know now only by these dry and sapless bones, were steaming with fragrant perfume and gaily painted with living colours? Or was it to teach that solemner lesson, read alike in the ponderous mountain, the solid earth, and—

> "In the Rose
> In its bright array—
> Hear'st thou what these buds disclose?
> 'PASSING AWAY.'"

Whoever rambles this coming Spring through "meadows green or upland lawn," through "wood or dingle," on "mountain-top" or "rugged heath" in search of wild flower, will be much the wiser, and very likely very much the happier, for having taken with them the charming bouquets of flowers, poesy, and scientific lore so elegantly culled by Miss Plues.

The Future; a Journal of Philosophical Research and Criticism, embracing the most interesting Results of Modern Discovery and Opinion in Cosmological, Antiquarian, and Ethnological Science. Edited by Luke Burke, Esq., F.E.S. 8vo. Trübner and Co. 1862.

Those of our readers who are fond of reading scientific subjects discussed in an open spirit, will be rejoiced to learn that the above periodical is again in existence, and will be regularly continued until further notice. The twenty-second number of the second volume, which is now before us, contains a spirited article on the battle in Section D, on the "great Hippocampus controversy," by the editor, who in a most eloquent and argumentative manner, whether we agree with him or not, attacks severally the dogmas propounded by Owen, Huxley, Rolleston, Flower, *et hoc genus omne*. To our geological readers, the second article on "The Primæval and Ancient World; or, the relative Epochs of Monumental History," will be more interesting. The author says: "The history of humanity, as revealed by its monuments, may be divided into eight great periods or eras, some of them of very long duration, and all presenting materials for subordinate stratification. These eras may be named, the Geologic, the Cromlech, the Cyclopean, the Pyramidal, the Eastern, the Classic, the Mediæval, and the Modern, the succession and contradistinction being very clearly indicated. The Geologic era may be considered as extending from the time of man's first appearance on this planet, until we meet with unequivocal vestiges of his civilized labours. During this long period, infantile humanity was gradually overspreading the earth, asserting its supremacy over inferior animals, and rehearsing the sad story of passion, conflict, and crime, which has been so often repeated in its subsequent annals. In certain more favoured centres, it was also slowly emerging from primal barbarism into incipient forms of civilization. This vast unknown space must doubtless cover its tens of thousands of years, and may hereafter have to be divided into several distinct epochs; but as yet it can scarcely be said to belong to archæology at all, so few are its known mementos, and so completely do these fall within the dominion of geology." It is perhaps needless to state that the sentiments advocated by Mr. Burke are of the most liberal character; and we trust full success may be achieved by this philosophical periodical, of which he is the energetic editor.

Science Elucidative of Scripture, and not Antagonistic to it. By J. R. Young. London: Lockwood. 1863.

Mr. John Radford Young is a mathematician of eminence, and was formerly professor in Belfast College. He makes no pretensions to being either a geologist or a theologian; but he is a sensible man; and, as a mere layman, "fully sensible by his own incompetency to do complete justice to the cause he has undertaken," he steps in to take part in a discussion which is every day rising to greater dimensions, thinking, that "when attacks on the Bible have to be repelled" it is likely a volunteer in the service may receive more willing and candid attention than would be given to "one whose sacred office and bounden duty it avowedly is," as he swears in his ordination oath, to "drive away all erroneous and strange doctrines contrary to God's word." As to the points in dispute, whether the Bible and creation or the Bible and science are in accordance, we have always set our face against expressing an opinion. On other occasions we have invariably maintained that the time was not come for a systematic and proper comparison. We think so still. The Biblicists generally know nothing of geology, and not a tithe as much as they ought to do about that very book, for the accuracy of whose every syllable they so senselessly contend, and for the due fitting of whose every piece with every possible doctrine or fact they so strenuously labour. The anti-biblical geologists, on the other hand, are often quite as senseless in their opinions as their antagonists. Mr. Young is too acute a man not to perceive some of the weak points in accepted geological doctrines; and if he do not always know enough to attack them with complete success, the well-directed fire of his artillery and its destructive power upon some parts of the groundwork, even of modern geological tenets, shows that the battle is not yet half fought out, and that the war will last, at least, until science is rid of those visionary speculations which some of her votaries have worked into her fabric, and which, like the rotten materials of the dishonest contractor, or the incoherent walls put together by incapable workmen, endanger the whole edifice in case of attack. When Geology and Scripture are brought into opposition, outsiders would do well to ask, What is Geology, and what is Scripture? When we have both replies, we might judge, probably very rightly, that as in the case of all quarrels, both sides were wrong, or at least not right,—which is pretty nearly, although not quite the same thing. If the Scripturists will *à priori* state *what* the Bible declares in respect to creation, or if they will give us a *correct* reading only of what the Bible does say; and if the geologists will give us—if they can agree amongst themselves—a correct version of the ancient history of our earth, then the public can judge well enough whether the two versions do agree or whether they do not. Until this is done, we do not think arguments will be much more conclusive than they have been. "Everybody knows," Mr. Young says, "that physical hypotheses are by no means necessarily physical truths;" but in geology some of these hypotheses, "originally invented to group together natural phenomena under some assumed generai principle, from which those phenomena may be logically deduced," have been commingled with theories or stated as facts.

It is but a few years since that we heard an eminent Fellow of the Geological Society say that the main work of geology was done, and geologists had only to arrange their materials and keep their collections in order. Since then we have had Sorby and others working at granites and metamorphosed rocks, and Darwin coming in with some stirring notions about the transmutation of species and the *imperfection* of the geological record. Latterly, too, the researches and speculations of Professors Thompson, Tyndall, and Haughton; the discoveries of Kirchhof and Bunsen; the experiments of Airy and Hawkins; and the progress made in chemistry, astronomy, physics, and all the other sciences, have made us feel, what is doubtless felt by every deep-thinking or observant mind, that the fabric of geology is not as solid as it ought to be, and the deductions from hypotheses or facts not always as satisfactory or as logical as one could wish them. It is only too true that there are matters of geology far more rickety than is quite pleasant to its defenders. "So long as geology lets the Bible alone it may go on constructing its theories as it pleases," says Mr. Young; but if these theories are paraded, in opposition to Scripture, as "geological truths, the grounds upon which they lay claim to this dignity must be examined." Whether this be correct, that geologists parade their doctrines in opposition to Scripture, or whether the outcry was not really raised by the opposite party against geologists, does not matter here. In both cases it is equally right that the doctrines of geologists should be submitted to as rigid tests as the words of the Bible. And so Mr. Young, as well as he is able, and sometimes ably, attacks the dogmas of geology. For example, giving in full the geologists' hypothetical assumption that the primary condition of the globe was a fluid molten mass, and the necessary corollaries of that assumption, that it has successively cooled down until a crust of aqueous deposits containing remains of their life-creations could be deposited from successive oceans, Mr. Young requests the reader to examine them, "and then, if he know anything of science in general, to ask himself if the fanciful scheme here depicted deserves to be called a strictly scientific theory. What is the primary assumption? Why, that the earth originally was a globe of fluid molten mass. Being a globe, all the parts of it equidistant from the centre must have been in same condition; and when, by cooling, the outer crust had forme d ry part of that crust must have been (at least, as to thickness) in the se condition. Upon this crust the internal molten fluid exerted an ex- ansive force (how it acquired this force is not stated) by which 'certain rts of it were pushed up,' while at the same time, or afterwards, certain ner parts 'suffered a corresponding depression.' Is this consistent, at the same expansive force should push up and pull down—be at once pelling and tractile? And why, seeing the physical necessity of uni- mity of condition of the whole, *all* the crust should not fare alike, is rd to conceive; and still harder is it to conceive that a piece of crust se up should go down again, or once down should go up again. Yet ese alternate up-risings and down-sinkings, this game of geological see- w, was not played out till twenty-eight or twenty-nine alternations had een gone through. But it must be admitted that though all parts of the rust had equal claim to rise or fall, yet the apparent want of fair play as, in the long run, equitably compensated; every part had its innings, nd the very ground which the reader now occupies has bobbed up and own at least eight-and-twenty times! Such is the doctrine in all the ooks." "Observe, too, in the foregoing detail of operations, the sort of o-partnery in the work between God and Nature—the ingenious division f labour. The Creator supplies the raw material already in a molten tate; Nature then takes it in hand, and shapes it and cools it, so as to fit he waters that surround it for marine tribes, which Deity forthwith sup- lies. Nature again steps in, and by upheavals presents to Omnipotence ome dry land, 'compatible with the existence' of land-organisms, with which it is of course speedily furnished; and so on, as narrated above."

Now, in this comment, although there is much that is defective, some hings not true, some apparently suppressed, and others exaggerated or caricatured, yet it really does hit well home, and the "internal heat doc- rine" and "the cooling-down theory" receive rather severe handling.

The upheaval of one part of the earth's crust while another is depressed, nd all elevations and down-throws of such masses, are readily accounted for by the *contraction* of the solid earth-shell *over* the internal fluid mass; but although one may "show cause why" such events or such phenomena *might* or could have happened, no one can handle these theories as weapons of defence against an acute antagonist without feeling their want of sharp- ness and temper. They may be correct, but it is certain they want proof and substantiation; and so long as geologists are content with fanciful hy- potheses and illogical deductions, so long will they fail to wield those pon- derous and irresistible arguments which this grand science is well able to furnish. This quotation will suffice to show that although Mr. Young's arguments may not be convincing, there is "food for reflection" in his writings.

His book is a small one, and cheap; the matter, probable as well as im- probable, lively, interesting, dogmatic, speculative, argumentative, and clever; and is well worth perusal, although we do not think Mr. Young brings the subject a bit nearer a settlement than his predecessors have done, or than his followers are likely to do in our time. The more works of this kind, the better for the cause of truth. Each puts forward the boldest and most telling points of his opponents; and if he fail to demolish them, he helps his enemy's cause instead of his own, and readers get enlight- ened by the failure as surely as by the success.

Cartes Géologique et Hydrologique de la Ville de Paris. By M. Delesse. Savy, 1861.

Rather more than a year ago, M. Delesse presented to the Geological Society of France two maps of the city of Paris, executed under the orders of M. le Baron G. E. Haussmann, Prefect of the Seine,—one a geological map of the subsoil of the city itself, as far as authorized actual excavations; the other hydrological, giving the quality and modes of flowing of the springs, especially of the subterranean watercourses. An ordinary geological map indicates only the rock found at the surface, but in the former of the maps the attempt is made to make known the nature as well as the form of the rocks which composed the under-soil. Such a labour is exceedingly difficult, and the more so that the rocks of Paris are remarkably varied; but the numerous works undertaken there of late years have offered unusual facilities for the comparison of sections.

The city of Paris is traversed by four superficial sheets of water—the Seine, the Bièvre, the stream of Ménilmontant, and the canal Saint-Martin. Independent of these, there exist the subterranean watercourses which are attained on the sinking of wells. These the hydrologic map shows in a very complete manner. The positions of these subterranean sheets are very interesting. There is pointed out, first, a subterranean sheet in immediate communication with the Seine, and designated the "infiltration-sheet" (*nappe d'infiltration*), which extends under Paris, and is that which furnishes the water of nearly all the wells. Its horizontal curves are undulating lines nearly parallel. They are disposed symmetrically on each side of the river, and accord with the superficial sheet. The level of the infiltration-sheet is generally above that of the Seine, and rises in proportion as it recedes from the banks of the river. Its form depends entirely on the river reproducing all its variations. Then the islands of Saint-Louis and Notre Dame are shown to have a distinct subterranean water-sheet, equally an "infiltration-sheet," with concentric horizontal curves nearly parallel with their contours; the sheet slightly elevated towards the central part, and inclining, on the other hand, towards the shores of the islands. Near the ancient barrier Blanche, some wells are fed by a subterranean sheet, of which the average is about 142 mètres. This sheet is above the lacustrine limestone, and is altogether distinct from the infiltration-sheet of the Seine. Near the ancient barriers Roche Chouart and Fontarabie, subterranean sheets are met with at an average of 137 mètres; these are also above the infiltration-sheet.

The map shows well the flowing of these subterranean courses. For example, in the infiltration-sheet of the Seine, which extends everywhere under Paris, it is seen that the water is necessarily directed from a higher to a lower point; and consequently, contrary to the ideas generally entertained, it inclines towards the shores of the stream. Thus, however paradoxical it may seem at first sight, the Seine plays, in respect to the subterranean sheet, the part of a draining canal; it determines the flowing of the water, and effects the drainage of the city.

VIEW OF THE COAL-MEASURE MOUNTAINS, NORTH AND SOUTH OF THE ARIGNA VALLEY, LOOKING N.W.

From the Limestone on Road near Drumshambo, Co. Leitrim.

THE GEOLOGIST.

MARCH 1863.

ON THE BITUMINOUS COAL OF THE ARIGNA DISTRICT, COUNTIES OF ROSCOMMON AND LEITRIM.

By George V. Du Noyer, M.R.I.A.,
Senior Geologist, Geological Survey of Ireland.

"Why is it that there is no bituminous coal of any account in Ireland?" This is a question which I have often been asked by well-informed people, and the answer is comprised in the one descriptive

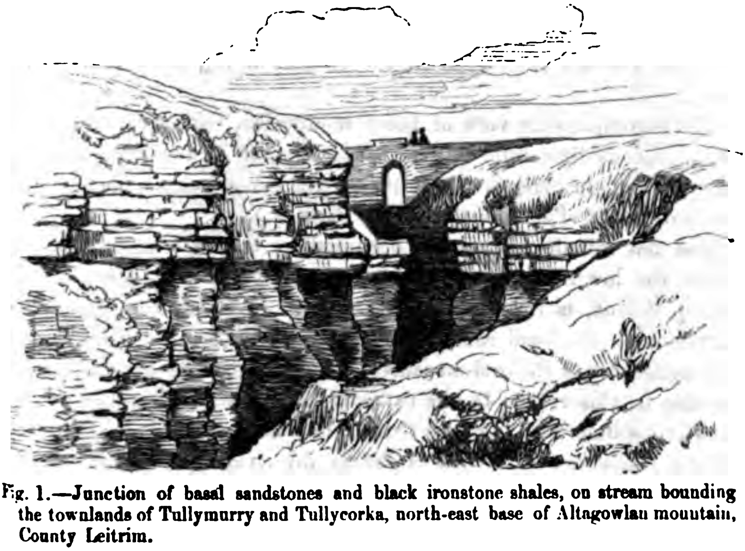


Fig. 1.—Junction of basal sandstones and black ironstone shales, on stream bounding the townlands of Tullymurry and Tullycorka, north-east base of Altagowlan mountain, County Leitrim.

word, "*Denudation.*" In truth, there is no reason why, at one period of our geological history, the great mass of the bituminous coal-bearing strata occurring in England should not have extended over what is now Ireland; but, strange to say, while this store of inestimable wealth was being preserved in England, and covered by the New Red Sandstone and probably Tertiary rocks, the adjoining portion of the earth's crust was being gradually raised from beneath the sea, and wellnigh effectually denuded of its carbonaceous covering. Ireland, therefore, for the most part, presents an older geological surface than England, especially over the areas now occupied by the Devonian and Carboniferous rocks; and I believe that all we have now remaining to us in the upper portion of the latter, is some of the basal beds of the English coal-measures, represented by three thin layers of bituminous coal, capping the mountains at either side of Lough Allen, in the counties of Roscommon and Leitrim, and extending into the Co. Sligo.

The most important coal-beds of the Arigna district, or those which are being worked at present, occur to the west of Lough Allen, and near the summits of the mountains of Kilronan and Altagowlan; the former being 1081 feet, and the latter 1377 feet above the sea, having the valley of the Arigna river between them.* From an examination of these coal-fields, which I made in the month of March, 1862, I am enabled to add some information to that which we already possess regarding them, which, I have no doubt, will be acceptable to those who are interested in the subject of the Irish bituminous coals.

The accompanying view of these mountains, taken from a boss of carboniferous limestone on the roadside near Drumshambo, on the way to the old Arigna iron-works, may convey some idea of the general aspect of the country. (See Plate V.)

The flat middle distance is occupied by the carboniferous limestone, the low ridge beyond, which rests on the S.E. flank of Kilronan Mount, is formed entirely of drift, derived from the disintegration of the local sandstones, dark grey grits, and black shales and ironstones of the coal-measures. The Arigna river passes through the gap in this ridge; to the extreme left of the view a boss of carboniferous limestone makes a feature in the landscape, and the slope of the hill above it, which is deeply intersected by small stream-courses, is composed of the black ironstone shales and dark grey

* The level of Lough Allen is 160 feet above the sea.

flaggy grits of the basal coal-measures. Above this, and forming the rugged scaur on the brow of the mountain, are the "Bottom Sandstones," or seat-rock of the coals; above them are the two coal-beds; the "crops" of which are defined by the level surface of the underlying sandstones, at either side of the mountain.

The summit is formed of sandstones, with dark grey shales, flaggy grits, and some nodular bands of clay ironstone (see Section).

The mountain to the extreme right is Altagowlan, and the two coal "crops" near its summit are clearly defined on its northern side, by the low precipitous faces of the sandstones with which the coals are associated.

By reference to the accompanying Sections, Nos. 1 and 2, the physical structure of both these mountains will be at once understood.

In order to afford a still clearer notion of the vast amount of denudation to which the whole of this district has been subjected, I give the subjoined diagrammatic section across it, from

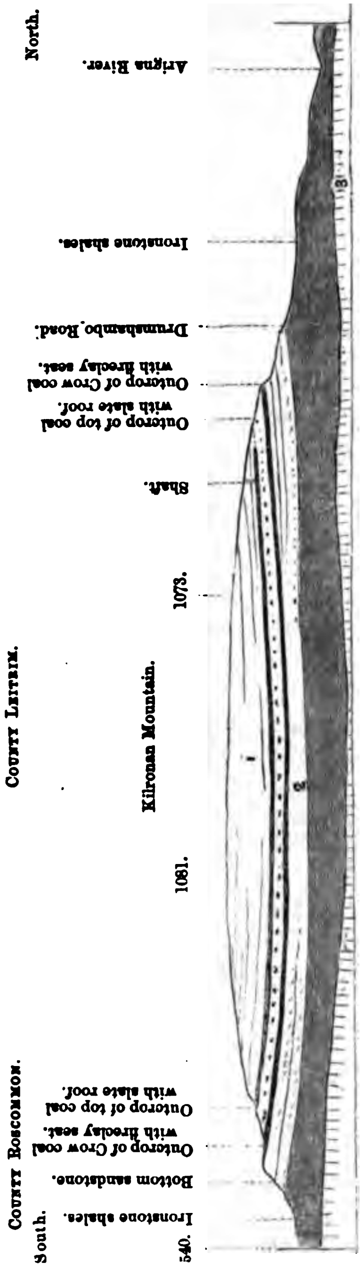


Fig. 2.—Section from S. to N. across the Townland of Rover.
1. Flaggy sandstone with black shales and ironstone nodules; 2. bottom sandstones; 3. Carboniferous Limestone.

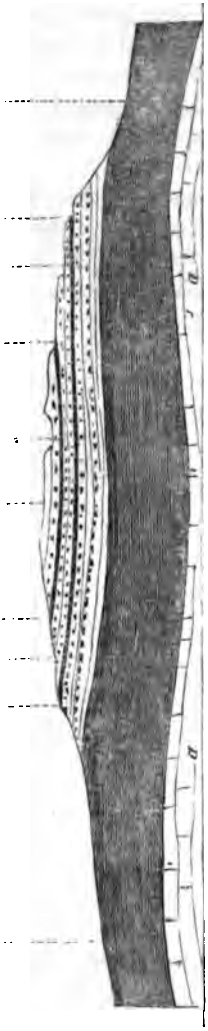
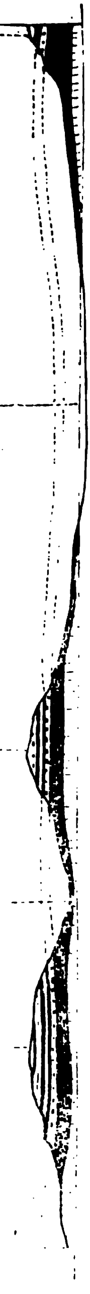


Fig. 3.—Section from S. to N. through the townlands of Altagowlan and Greaghnaslieve. *a, a,* Probable position of Carboniferous Limestone.



Mountains between Drumshambo and Drumkeriu.
Scale 3½ inches to 6 miles.

MAP OF THE ARIGNA COAL FIELDS.

Illustrating Mr. Du Noyer's observations on the Bituminous Coal of the Counties Leitrim and Roscommon.

rest to east, commencing at the limestone to the west of Kilronan Mount, and ending on the western side of Slieveanerin Mount, which ises to the east of Lough Allen, a distance of twelve miles.

From this it will be very apparent that a little more denudation, and the coal-beds which cap the mountains would have been removed.

In the year 1788, a speculation, under the name of the Arigna Company, was set on foot to smelt the iron ores of the district around Lough Allen, and operations were commenced by erecting extensive smelting furnaces on the south bank of the Arigna river, within a mile and a half of Lough Allen and three and a half miles from Drumshambo. The coals were procured from the pits at Aghabehy and Rover, and a tramway of nearly three miles in length was constructed to facilitate their transit to the works, from the former and more distant colliery.

In the year 1818, Sir R. Griffith compiled a mining and geological report on the Connaught coal-fields, in which a rather too favourable opinion was expressed as to the thickness, extent, and quality of the coals; this he however subsequently modified.

In 1830, Mr. Twiss made a report on the Arigna ironstones, for the directors of the Arigna Company, in which he speaks in the highest terms as to the quality of the ore, the amount of which he regards as inexhaustible. After a trial, extending over a period of about thirty-five years, the Arigna Company failed, and this serious mishap to a most legitimate mining undertaking forms a prominent feature in the history of Irish stock-jobbing speculations.

In 1838, the Railway Commissioners' Report on the Connaught coal-fields appeared, and it is therein stated that the total area occupied by coal covers 20,000 acres, representing a bulk of 20,000,000 tons. At present the coals raised from the old pits in the Arigna district are only sufficient to supply the mere local market, and have been estimated by Sir R. Kane, in his 'Industrial Resources of Ireland,' to be about 3000 tons annually. With regard to the Kilronan and Altagowlan coal-fields, so far as I can judge, I see little prospect of their being properly developed, chiefly from the apparent exacting spirit evinced by the owners of the royalties, based upon an exaggerated notion as to the extent and bulk of the coals, and ignorance as to the difficulty of procuring them.

The total extent of the coal-beds in this district and that which lies to the west of it, stretching into the Bralieve range of mountains, is about 5 miles from N.W. to S.E., with an average width of about 1 mile at Kilronan mountain, which forms the eastern termination of that long narrow coal-measure basin. The Altagowlan basin, on the opposite side of the Arigna valley, may be about 8 miles, from N.W. to S.E., with a width of three-quarters of a mile. In these areas there are but three beds of workable coal, the thickest of which is not over 2 feet 6 inches, and one of the beds has its roof and floor of hard sandstone. See "upper coal seam of Creughnaslieve."

The following is Sir R. Griffith's section of the Kilronan Mount coal-measures, taken from his 'Mining Report on the Connaught Coal-fields,' and its general accuracy is undoubted:—

Strata.	Feet.	Surface.
18	30 to 50	Sandstone flags.
17	30 to 60	Blackish-grey sandstones and gritty slate.
16	100 to 200	Slate clay, in beds of variable thickness and hardness, and containing innumerable beds of clay ironstone.
15	Coal.	Third or upper seam, 8 to 9 inches thick (?).
14	24 to 45	White sandstone.
13	10 to 15	Grey soft slate clay. Coal roof.
12	Coal.	Second coal, 2 ft. 6 in. to 3 ft. 4 in. (Over-estimated.)
11	12 to 15	Sandstone.
10	6 to 15	Black slate clay.
9	4 to 20	Greyish-white sandstone.
8	Coal.	Third or "Crow" coal, intermingled with clay laminæ, 1 to 3 feet. (Over-estimated.)
7	1 to 3	Fire clay. Coal seat. (Over-estimated.)
6	1 to 3	Sandstone, with plant impressions. (Often much thicker.)
5	6 to 10	Grey (and very hard) sandstone.
4	9 to 20	Black slate clay (shale).
3	30 to 60	Greyish-white sandstone, known as the first or bottom sandstone.*
2	300 to 600	Black slate clay, with grey flags, and innumerable ironstone nodular layers and beds, varying from half an inch to 2 feet in thickness.†
1		Carboniferous limestone, unknown. Page 20 of Report.

As my examination of these coals was confined to the Arigna district, and had distinct reference to those places where *coal* is now being raised, I shall limit my remarks to the facts which came under my own observation, as by so doing I shall afford some aid to future explorers in this most interesting and important field of research, and I cannot prejudice the question as to the advisability of these beds being worked as a profitable mining speculation.

* Upwards of 250 feet thick at Altagowlan, and close on 200 feet on the south-east flank of Kilronan.

† Upwards of 800 feet at Altagowlan mountain.

I traced the outcrop of the two coal-beds around the entire north-n, eastern, and southern limit of Kilronan Mount; devoting my tention specially to those which appear in the townlands of Aghabehy, ullytawen, and Rover, and in those of Carrownaualt, Derreenavoggy, d Cross Hill, on the eastern brow of the mountain. On the other de of the Arigna valley I examined particularly the coal "crops" in e townlands of Greghnaslieve, Tullytawen, and Seltennaveeny, ithout however having had time to connect them accurately over e intervening spaces. Their position as indicated on the map, and the ults disturbing them, will not, however, be very far from the truth.

The following observations are extracted from my field notes:—

1. *The Aghabehy Coal-field.*—This lies on the northern slope of Kilronan mountain, at an elevation of 510 to 899 feet above the level f Lough Allen, from which it is distant about six miles by the oad; there is here but *one* bed of workable coal, called "the top coal," 1 foot 6 inches in thickness, which includes 6 to 8 inches for holing. The roof of this coal is slate, and the floor sandstone. The second, or ower coal, or "crow coal," is separated from the first by 20 to 55 eet of very hard sandstone; it has a thin fire-clay seat with a sand-stone or "rock" roof; and is 6 to 8 inches thick, it is full of thin eams of earth, and yields only culm of an inferior quality. The culm derived from the "holings"* of the top seam is very superior, and cokes well. Blocks of a light, flaky, and glistening coal, measuring 3 to 10½ inches in thickness, are now being delivered at the pit-mouth, at the cost of 5*s*. 6*d*. a ton, including the culm; a ready sale is effected for this at 10*s*. per ton for thick and screened coal, and 8*s*. per ton for the culm, giving however to every ton of culm 4 cwt. of the thick coal. When struck with the hammer, I remarked that these blocks of coal shivered throughout their bulk, which induced me to suppose that they would not bear any rough treatment in their transit over long distances.

From the northern outcrop of the "top coal" in the N.W. portion of the townland of Aghabehy, and at the stream near the road, a fault has been proved, causing a downthrow to the west of about 100 feet; it strikes from this point South by Fast to the shafts near the top of the hill, a distance of about 850 yards, or half a mile. From this point I believe it strikes S.S.E. into the adjoining lowland of Tully-

* The term "holing" is applied to that portion of the bottom of the coal-seam which, in the absence of a Fire clay "seat," is picked away by the miner in order to extract the coal above in blocks. In this instance, the refuse makes excellent culm.

tawen, for the distance of three-quarters of a mile to near the farm-houses of the latter townland, when I think it will be found to strike S.S.E., and with that bearing to leave the district.

It is a somewhat remarkable fact, that on the eastern side of the fault just alluded to, the coals have never been accurately proved or their outcrop defined, with the exception of a small space east of the shafts, at the distance of one-third of a mile above the chisel-pit.

The townland of Tullytawen lies to the south of Aghabehy, on the southern slope of the mountain, and is traversed by the Aghabehy fault, which cuts off the coals by a downthrow to the west. I was informed that the "top coal" here measures 1 foot 6 inches in thickness, with a *fire-clay seat of* 3 *inches*. The "crow coal" is stated to be here 6 inches thick. Considerable workings have, for many years back, been made in the "top coal" at this locality; but as at Aghabehy no record was kept of the amount of coals extracted, and as the workings were on the pillar-and-stall plan, no sooner was the coal extracted than the roof and floor were allowed to collapse, and thus to obliterate all traces of the works.

The "top coal" has been rather extensively worked, at the townland of Rover, which joins Aghabehy on the east.

In the townlands of Carrownanult, Darreenavoggy, and Cross Hill, the outcrops of the two coals is very well seen. The top seam is, however, by all reliable accounts, lessening in thickness at this portion of the coal-field, and is only 12 inches thick, while the crow coal is only 6 inches; here we find that the basal sandstones are thickening, while the coal is thinning. It is just as probable, however, that in the Western portion of the coal-field of Kilronan or that which extends into the Co. Sligo, the coal may thicken and improve in quality. Around the circuit of the eastern termination of Kilronan Mount, the coal-measures are traversed by at least six faults radiating from the centre of the hill; of these the most considerable occurs in the south-west portion of the townland of Kilronan mountain, but owing to the flatness of the beds, which dip often as low as 3°, a slight dislocation in their continuity would throw a coal crop hundreds of yards out of its line of strike. The faults therefore which occur to the east of that at Aghabehy would be of no importance in the event of the coals being worked, as their direction and throws could be most accurately determined and calculated.

2. *The Greaghnaslieve and Altagowlan Coal-fields.*—This area which appears to afford the most valuable coals in the district, lie

an elevation of between 710 and 1209 feet above the level of ough Allen,* from which it is distant about three miles; a most :cellent road leads from the lake to within 400 yards of the out-op of the bottom seam of coal. The lower coal has here a slate ›of, from which fact, I should suppose that it corresponded to the op coal of Aghabehy, and the upper coal here would therefore agree ith the thin seam, numbered 15 in Sir R. Griffith's section, and which s thinly developed in the district to the west of Kilronan mountain. Though this may be probable, I am aware that it is unsafe to attempt o identify coal-seams merely from a correspondence in their "roof" or "seat. At the outcrop of the lower coal, along the northern brow of this mountain, the strata are clearly seen to have a slight dip away from the hill, or to the north-east. This is explained in the Section No. 3, which shows that this portion of the coal-measures forms the northern side of a low anticlinal, the prolongation of which to the north has been cut off by the denudation; by tracing these beds, however, up the mountain, they are found, as a mass, to be bent synclinally and to form a shallow basin. The *rise* therefore of the coal to the hill, on its northern flank, which causes the beds to be self-draining, will, in all probability, be found to cease in the distance of 250 yards.

The lower coal-seam of Greaghnaslieve afforded the following section on the northern face of the mountain:—

Seat rock, sandstone.

Holing 6 to 8 inches in brown sandy clay, and slightly micaceous shale, answering to an impure fire-clay.

Fire-clay coal, or fire-clay, with numerous bituminous layers and strings through it, 8 to 10 inches.

Coal from 1 foot 4 to 1 foot 6.

Roof, black slate clay, 7 to 10 feet.

Rock roof, sandstone.

In my table of thickness, etc., of the coals, I have called this the two-foot coal.

The upper coal seam, or that nearest to the top of the mountain, was not as well exposed as the lower. I traced its outcrop across the townland, but had not an opportunity of examining it closely. I was informed, however, that it is of equal thickness with the lower seam, but it wanted the shale holing, and its roof and floor is sandstone or "rock;" we may therefore value it as an 18-inch coal.

From the inaccessible nature of the ground in the townland of Altagowlan, and its proximity to that of Greaghnaslieve, it is evident that the whole of this coal-bearing area should be worked from the northern side of the mountain. I believe that the quality of the Greaghnaslieve coal is the same as that from the Seltanaveeny Pits.

3. *The Seltanaveeny Coal-field.*—Extensive operations have been carried on here for many years back in the northern part of this townland, adjoining that of Tullynahaw, and shafts to the depth of 120 feet have been sunk in the coal; from the comparatively low position of this ground and the fact that this portion of the coal-field is formed by the stream S.E. end of the Altagowlan basin, and the coal at its outcrop dips to the hill in every direction, great difficulty will ever be experienced in freeing the workings of water. (See map.)

The distance to the lake from those pits is four miles, by the new road to Greaghnaslieve, or two and half by the old and at present broken-up road leading from Tullynahaw colliery.

The subjoined is my estimate of—

THE THICKNESS, AREA, AND WEIGHT OF COALS IN THE FOLLOWING TOWNLANDS, FORMING PORTION OF THE ARIGNA COAL-FIELDS, COUNTY ROSCOMMON.

	Townlands.	ft.	in.	Acres.	Tons.
	North-west Coal-field.				
	Greaghnaslieve, lower seam	2	0	100	200,000
	Greaghnaslieve, upper seam	1	9	60	95,000
	Altagowlan, lower seam	2	0	94	188,000
	Altagowlan, upper seam	1	9	42	73,500
				296	556,500
	South-west Coal-field.				
Top coal.	Aghabehy, proved area	1	6	36	54,000
Top coal.	Aghabehy, unproved area	1	6	133	199,000
Top coal.	Tullytawen, proved area	1	6	18	27,000
Top coal.	Tullytawen, unproved area	1	6	67	100,000
Top coal.	Rover, partly proved	1	6	120	180,000
				468	561,000
	South-east Coal-field.				
	Carrownanalt, Derreenavoggy, Crosshill	1	0	179	179,000
				179	179,000
	North-east Coal-field.				
	Saltanaveeny, available	2	0	72	144,000
				72	144,000

he accompanying table certain townlands are given which form etached portions of the two great coal-fields.

it may interest some of our readers, I subjoin the analysis of igna coals, and that of the ironstones, as given in that valuable on the 'Industrial Resources of Ireland,' by Sir Robert Kane d edition, p. 23):—

hababehy Coal.—A rich black coal, easily broken. Specific gra-·274. When heated, it gives off a good deal of inflammable d leaves a light, porous, grey, coherent coke. Analysed in this was found to give, from 100 parts:—

Volatile matter	23·10
Pure coke	66·15
Ashes	10·75
	100·00

e part of this coal reduced twenty-six parts of lead to the ic state; one hundred parts of it, therefore, represented seventy-parts of pure carbon.

ltanaveeny and Meenashama Coal.—Specific gravity, 1·290.

	Seltanaveeny.	Meenashama.
Volatile matter	19·10	18·90
Pure coke	65·87	61·46
Ashes	15·08	19·64
	100·00	100·00

ver Coal.—Specific gravity, 1·287.

Volatile matter	17·70
Pure coke	74·89
Ashes	7·41
	100·00

ne part of it gave by ignition with litharge 28·4 parts of lead; one hundred parts of the coal corresponded to eighty-four of carbon.

he actual elemental composition of Aghabehy and Rover coals ound to be as follows:—

	Aghabehy.	Rover.
Carbon	79·69	81·04
Hydrogen	6·24	4·91
Oxygen	3·52	6·64
Ashes	10·75	7·41
	100·00	100 00

"*Clay Ironstone Nodules from Arigna.*—**Mean of five analyses:—**

Protoxide of iron	51·36
Lime	1·59
Magnesia	1·92
Alumina	0·98
Insoluble clay	12·82
Carbonic acid	31·33
	100·00

And this contains 40 per cent. of metallic iron.

"The loss by calcining, the iron remaining as protoxide, should be in average 31·33 per cent.; and the calcined ore should consist of 100 parts of

Iron	58·2
Oxygen	16·6
Lime and magnesia	5·1
Clay	20·1
	100·00"

(See Sir R. Kane's 'Industrial Resources of Ireland,' p. 136.)

CORRESPONDENCE.

Crocodilian Remains in the Scottish "Old Red."

SIR,—Observing that the report of a Scottish crocodile having been found in the Old Red Sandstones of Morayshire has been commented on in your Notes and Queries for February, I think it right to state that no reptilian remains have been recovered from any of the sandstones of that county, of whatever age, with the exception of those of the well-known Telerpeton, Stagonolepis, and Hyperodapedon.

The stone containing the first of these, the *Telerpeton Elginense*, was got from a quarry near the Loch of Spynie, some two to three miles south of Elgin, by the late Mr. Patrick Duff, and is now in my possession. It is described and figured by the late Dr. Mantell (Jan., 1852), in a paper contained in the eighth volume of the 'Geological Journal,' as a small lacertian reptile, about four and a half inches in length.

The *Stagonolepis Robertsoni* has been long known, and was so named by Agassiz, and is by him described, in the 'Poiss. Foss. du Vieux Grès Rouge,' as a ganoid fish. The discovery of many fragments of bones since has enabled Professor Huxley to fix the true nature of these remains. The Stagonolepis is described by him, in the fifteenth volume of the 'Geological Journal' (1858), as a reptile having considerable affinities to the crocodile, and as having reached from 16 to 18 feet in length. Many remains of bones and scutes belonging to this creature have been found in a quarry at Lossiemouth, some five miles south of Elgin, and are preserved in different museums, as in that of Elgin, the Museum of the Royal School of Mines in Jermyn Street, etc.

The remains of *Hyperodapedon Gordoni* were got from the same quarry rds those of Stagonolepis, by the Rev. G. Gordon, of Birnie, and in a note to a paper on the sandstones of Elgin by Sir Roderick , also published in the fifteenth volume of the 'Geological It is supposed to have been a Saurian reptile, of from 6 to 8 feet

these, numerous slates covered with reptilian footprints are from ne dug from the neighbouring quarries of Cummingstone. dstones containing these remains were originally believed to be- upper division of the Old Red Sandstone series, and are de- such by Sir R. Murchison in the paper above referred to. In that paper, however, it is remarked that, in consequence of the nization of these reptiles, and their affinity to those found in strata, and as the stratigraphical relation of these sandstones with bted Old Red Sandstones of Elgin cannot, from overlying soil, be determined, there is considerable reason to suppose that they may a more modern epoch; and since that time they have been looked t geologists as Triassic. The question of age has again been lately by the discovery of footprints similar to those of Cum- in sandstones, believed to be Old Red, in Ross-shire. At present remature to give any opinion as to the true position of these us sandstones; but, as this is being very carefully wrought out ualified parties, it is to be hoped that a short time will suffice set at rest this *quæstio vexata*. JAS. POWRIE, F.G.S.

, *February* 12, 1863.

Analysis of Red Chalk.

SIR,—The article on the above subject, by R. Calvert Clapham, e 'Geologist' for January, 1863, p. 29, will no doubt have been pleasure by geologists taking interest in such matters, more those who study the chemical properties of the two strata in the article above alluded to. At the same time I beg to refer rt Clapham to a paper on the Red Chalk of England, by the Wiltshire, in the 'Geologist' for 1859, p. 161. In speaking lysis of the Red Chalks of Speeton and Hunstanton, Mr. Wilt- that "one of the members of the committee of the Geologists' n, Mr. Rickard, has been good enough to make me an analysis. peeton is as follows:—

Carbonate of lime, with a little alumina	81·2
Peroxide of iron	4·3
Silica	14·5
	100

nstanton—

Carbonate of lime	82·3
Peroxide of iron	6·4
Silica	11·3
	100

ove results of Mr. Rickard are nearly the same as those pro- Mr. Calvert Clapham. The latter gentleman seems to have paid ute attention to the minor contents of the substances analysed.

Mr. Calvert Clapham states that "at Speeton it (the Red Chalk) is in some places a soft red clay, and is used to colour bricks and red pottery." Whenever the Red Chalk is found soft, like clay, at Speeton, it is because of its being displaced from its original bed and ground to a powder by large masses of white chalk which overlie the red chalk, falling upon it, and then the rains falling upon, or small streamlets passing through it, give it the consistency of "soft red clay;" but it is not to be found in a soft clayey state *in situ*. I must beg respectfully to state, that Mr. C. Calvert is labouring under a mistake, when he states that the red chalk is used at Speeton for colouring either bricks or rough pottery: it is not so used; but an article very much the same in colour is used, viz. Venetian red, a sample of which I enclose for your inspection, and remain,

Your obedient servant,

EDW. TINDALL.

Mammalian and Human Remains, Isle of Portland.

SIR,—Will you allow me to send you some remarks relating to an account, in the 'Times' of the 1st of January last, of some human and other bones which have been discovered associated together in fissures of the rock of Portland Island, during the building of the fortifications there?

The following is the passage in the 'Times:'—"The sections of the wonderful geological strata which form the Island of Portland are seen for the first time, in the straight rocky walls of the ditch, in all their curious variety. What is most singular is, that at regular intervals of twenty-five or thirty yards, and commencing about twenty feet below the surface of the ground, are a series of vertical faults or gaps, about two feet wide, which, as far as can be judged, penetrate to the lowest substrata of the island, and traverse it completely from north to south. In these extraordinary clefts, human bones have been found, with those of wild boars and horns of reindeer, not fossilized, but with all their osseous structure as perfect as if they were not fifty years old."

In 'Willis's Current Notes' for August, 1852, there is a nearly similar account of human and other bones found in the fissures of the Portland rock. The account says:—"It appears that in the year 1844, some human bones were discovered on the ledges of a fissure in a quarry belonging to Mr. Weston, at different depths, from twenty-five to forty feet. These fissures run parallel with each other throughout the island, from north-east to south-west, at stated distances, varying from forty-five to sixty feet, and the quarrymen say that they always know when they are coming near to them from the form the upper layers of loose stone and rubble assume, losing their longitudinal stratification, and having all the appearance of having been dragged out of their position by a mighty rush of water from above into the fissure. These fissures do not extend to the surface-soil by five or ten feet, and run down to the blue clay, through the several strata of stone, etc., to the depth of from eighty to a hundred feet, having many ledges or shelves in them, and generally covered with stalactitic formations. On several of these ledges a number of bones of all kinds of animals were found, including those of the human species. These were preserved and shown by Captain Manning to the late Rev. Dr. Buckland, on his next visit to the Castle; but the doctor having doubts as to the place where they were found, accompanied Captain Manning to the fissure, where a lad was let down who brought up more of the bones in his presence.

sor Buckland stated as his opinion, that the mass of matter of which sland of Portland is composed on drying cracked and so formed fissures. But how is it these fissures did not extend up to the sur-)il, where the evaporation must have been greatest, and where there rs no trace of them? Several teeth and a tusk of an elephant have ly been discovered in the dirt-bed of the Portland quarries."

truth of these facts mentioned in the 'Current Notes,' which, in all ial circumstances, are similar to the facts mentioned in the 'Times,' en confirmed to me by Captain Manning himself, who has several shown me, at Portland Castle, human and other bones, and amongst those of the elephant, which have been discovered in the fissures of 'ortland rock. Captain Manning stated that these fissures did not d to the surface of the rock.

truth of these geological facts may be easily ascertained by any n visiting Portland Island.

human and other bones have been found in fissures which have no unication with the surface of the earth and are covered with solid must they not have entered the rock before its consolidation, and, quently, when it formed part of the bed of the sea? And must not, 'ore, the men and animals to whom the remains belonged have inhabited other dry land, which probably no longer exists? And does not this r probable the opinion of M. Cuvier, expressed in the following :—"I conclude, with MM. De Luc and Dolomieu, that if there be 'act well established in geology it is this, that the surface of our has suffered a great and sudden revolution, the period of which t be dated further back than five or six thousand years. This revo- has, on one hand, engulfed and caused to disappear the countries rly inhabited by men and the animal species at present best known; on the other, has laid bare the bed of the last ocean, thus converting annel into the present habitable earth"?

period of this revolution, which MM. Cuvier, De Luc, and Dolo- believe to have been effected by an interchange of land and sea, ronizes very nearly with the one usually assigned to the Mosaic ge.

Your obedient servant,

THOS. D. ALLEN.

tory, North Cerney, Cirencester, Jan. 23, 1863.

Glyptolepis—Dura Den.

AR SIR,—The Rev. Mr. Mitchell, in his communication regarding enus in your number for February, omits to mention that the dis- y that what formerly used to be named *Holoptychius Flemingi* is lity a species of Glyptolepis, is by no means quite new.

attention of Professor Huxley, Mr. Robert Walker, of St. Andrew's, myself, having been directed to the Dura Den fishes, in consequence her extensive excavations in the Den, which, through the kindness s. Dalgleish, were allowed to be made in the summer of 1861, for hing specimens to the St. Andrew's Museum, we seem indepen- y to have arrived at that conclusion. Towards the end of last er, in writing me, of date 24th September, 1862, Mr. Walker states, at was rather a curious coincidence," etc., "I left the Museum with tty strong conviction that the scales of *Holoptychius Flemingi* and tolepis appeared to be one and the same, when here comes your letter to strengthen that conviction." (I had just written him to that effect.) Mr. Walker has, undoubtedly, the merit of first making this discovery public; this he did in an admirbale paper, describing most accurately this species, *H. Flemingi*, and stating his conviction that it belonged to the genus Glyptolepis. This paper was read on, I think, the 22nd of November last, before a meeting of the Literary and Philosophical Society of St. Andrew's, and has since been published in the 'Annals and Magazine of Natural History.'

Not only must the *Holoptychius Flemingi* hereafter be looked on as belonging to the genus Glyptolepis, but it seems to me exceedingly probable, that Holoptychius may ere long be altogether merged into that genus. The only species of Holoptychius on which I have never yet been able to detect scales, showing the crescent of points on the anterior half so characteristic of those of Glyptolepis, is *H. Andersoni*, and this I am at present inclined to think not a good species at all. Of *Holoptychius giganteus*, the only good specimen I have yet examined is the superb one in the collection of Lady Kinnaird; of this it is the ventral surface which is exposed, and on the anterior portion the scales show very distinctly the characteristic markings of the *Holoptychius giganteus* of Agassiz; along the flanks on both sides they as clearly assume the Glyptolepis character, in many instances showing the crescent of points so distinctly as to be readily observed by the unaided eye, while towards the tail the scales assume the exact appearance of those on *Holoptychius Andersoni*; indeed, so exactly does this fish resemble *H. Andersoni* in form, in the comparative size and disposition of the scales, in the position, structure, and form of the fins, so far as preserved, in the comparative size and form of the head and jugular plates, indeed in everything except size, that I am much inclined to think *H. Andersoni* the young of *H. giganteus*, increased age developing the different sculpturing on the scales. Mr. Walker refers in his paper to a very imperfect specimen of this fish in the St. Andrew's Museum, the scales along the flanks also showing the crescent of points on the anterior half, the others resembling those of *H. giganteus*. Mr. Walker also pointed out to me what I fully concur with him in thinking a species, nearly allied to, but distinct from *H. Flemingi*, with which it seems hitherto to have been confounded, and in this every scale sufficiently preserved appears to have the crescent of points as in Glyptolepis. In a specimen now in my possession, which was obtained by the late Mr. P. Duff of Elgin, from the Bishop Mill (Elgin) sandstones, and which has been named, I think correctly, *nobilissimus*; I have also been able to detect one scale having the crescent of points well preserved, and I am informed by Professor Huxley, that the typical specimens of *Holopt. Sedgwickii*, in the Cambridge Museum, present unmistakable Glyptolepis scales.

Mr. Mitchell mentions a Paper communicated by me to the Geological Society of London, and published in their Journal for November last, in which I first drew attention to the occurrence of Glyptolepis scales in the Dura Den Sandstones, and in which I notice a fish as a new species of Glyptolepis. This fish, however, I now believe to belong to some other, probably new genus, the caudal and other fins, as well as the general form too little resembling Glyptolepis, while of the scales it is only the internal structure which is shown, and although on one or two the external sculpturing is imperfectly preserved, yet the body where these are situated being a good deal twisted, they may have belonged to some of the many other fishes scattered over the flag on which this is preserved.

Thus at present stands the case Holoptychius *versus* Glyptolepis; it is however, being carefully wrought out, and as Mrs. Dalgleish has most generously consented to allow still further excavations in the Den, I have little doubt but that this question will be decided during the course of next summer.

Yours, etc.,

JAMES POWRIE, F.G.S.

Reswallie, February 18th, 1863.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

GEOLOGICAL SOCIETY.—*January 21st.*—1. "On a Northerly Extension of the Upper Silurian 'Passage-beds' to Linley, Salop." By Messrs. George E. Roberts and John Randall.

Sections obtained along the course of Linley Brook, near Bridgenorth, Salop, were shown to exhibit an ascending series of deposits from Aymestry shales, through Upper Ludlow rock, Downton sandstones (with bone-bed), grey shales and grits (with bone-bed), and plant-bearing shales, to Old Red clays. The lower bone-bed was stated to be chiefly composed of scales of Thelodus and broken Lingulæ, and the higher one to contain a more than usual abundance of fish-spines; and it was remarked that crustacean remains were altogether absent, but *Lingula cornea* had a range upwards to the Old Red clay. The authors considered the physical conditions of the period to be those indicated by Sir Roderick Murchison in his remarks upon the change in the character of the sediments which closed the Silurian epoch. The occurrence at Trimpley, and elsewhere, of a cornstone-band in the plant-bearing shales, was noted as giving a more defined basis for the Old Red Sandstone.

2. "On some Crustacean-tracks from the Old Red Sandstone near Ludlow." By George E. Roberts, Esq.

Tracks of a crustacean found by Mr. Alfred Marston on a thin sandstone layer, lying between two bands of cornstone at Bouldon, seven miles north of Ludlow, were exhibited by the author, and doubtfully referred to Hymenocharis. The sandstone in question was stated to be rich in crustacean and annelidan tracks and trails. The lower cornstone in the section exhibited at Bouldon was referred to the horizon of the plant-bearing shales of Linley.

3. "On the Parallel Roads of Glen Roy, and their place in the History of the Glacial Period." By Professor T. F. Jamieson.

After describing the general appearance of the roads, the author referred to the different theories that have been framed to account for them, giving his reasons for considering both the marine hypotheses untenable, and pointing out the evidences in favour of Agassiz' theory of a dam of glacier-ice having supported a freshwater lake. He especially dwelt upon the coincidence between the height of each of the parallel roads and that of a neighbouring watershed, but also remarked upon the objections to a glacial barrier, explaining how it might have shrunk at three successive periods, so as to allow of the formation of the three roads. He then showed that the period of the formation of these roads must either have been posterior to that of the submergence during the Drift period, or that the sea did not reach them during the submergence; also, that it was prior to the formation of the forty-feet raised beach of Argyleshire.

Professor Jamieson concluded by stating that his examination of Lochaber had led him to infer that the parallel roads are the beaches of ancient freshwater lakes, which arose from glaciers damming the mouths of the valleys and reversing their drainage, at a date subsequent to that of the great land-glaciation of Scotland, owing to a re-extension of the glaciers after the chief submergence of the Drift period.

February 4th.—1. "On a Hyæna-den at Wookey Hole, near Wells."—No. II. By W. Boyd Dawkins, Esq., B.A., F.G.S., of the Geological Survey of Great Britain.

The former but partial exploration of this cave by the author convinced him of the desirability of a more rigorous examination, the details of which were given in this paper, with a Table of the species of Mammalia whose remains were met with, showing the distribution of the teeth and bones in the several parts of the cave, and also a statement of the general results arrived at. A consideration of the distribution of the remains in the cavern and their close juxtaposition to the roof, coupled with the fact that the flint and chert implements discovered were found in much lower positions, led Mr. Dawkins to infer that the bones had been dragged in by hyænas, and that the cave had been subjected to periodical inundations of waters laden with red mud, whereby the bones had been elevated by degrees until they occupied their present position. After a detailed description of the bones, the author concluded by some general remarks upon the bearing of this cave-fauna upon the ancient physical geography of the district, and the antiquity of the associated implements of human manufacture.

2. "On the discovery of Paradoxides in Britain." By J. W. Salter, Esq., F.G.S., of the Geological Survey of Great Britain.

A short sojourn in the neighbourhood of St. David's enabled Mr. Salter to discover, at Porth-rhaw, near Whitchurch, on the St. David's road, a gigantic Trilobite belonging to a genus which has been long sought for in the British Isles. The author gave a short description of the geological features of the locality, and a section showing the succession of beds belonging to the Primordial Zone in Wales, as well as a diagnosis of the newly-discovered Trilobite, which he named *Paradoxides Davidi*.

3. "On the Fossil Echinidæ of Malta." By Thomas Wright, M.D., F.G.S. With Notes on the Miocene Beds of the Island, by A. Leith Adams, A.M., M.B. (22nd Regiment.)

The Echinoderms, described in this paper by Dr. Wright, were discovered by Dr. Leith Adams, during a careful examination of the strata and geological features of Malta. A description of the miocene beds was given by the latter gentleman, in which he stated his reasons for not accepting entirely the classification of them proposed by Captain Spratt, and followed by Earl Ducie in his Geological Map of the Maltese Islands. He divided the miocene strata into the following subdivisions:—1. The Upper Limestone; 2. The Sand Bed; 3. The Marl; 4. The Calcareous Sandstone; 5. The Lower Limestone; and again subdivided the Upper Limestone into three parts. Dr. Wright gave a diagnosis and detailed description of forty species of Echinidæ, eighteen of which are new; and Dr. Adams added a Table showing their stratigraphical distribution.

February 20th.—The anniversary meeting at Somerset House was rather thinly attended. The obituary notices included the names of Trench, Leonhard, Rev. J. Cumming, Bronn, Bertrand de Doue, J. C. Nesbit, and the Marquis of Breadalbane. The Wollaston gold medal was awarded to Prof. Gustav Bischoff, of Bonn, for his work on Chemical Geology; the Wollaston fund to Professor Senft, of Eisenach, to assist him in his labours in the classification of rocks. "His work on that subject," the president remarked, "was of high esteem in Germany, and would no doubt be held so in this country when it was known here." The presidential address consisted of details of the lines of stratigraphical and palæontological discordances, and the horizons of unconformability in the Palæozoic group of rocks. Professor Ramsay said that it had been a practice with previous presidents to review the chief geological results of the past year in the anniversary address, but want of time had precluded his doing so, and he had therefore selected a special topic, the first part of which he now read to the meeting, and the continuation of which he would complete on the next like occasion.

In the debate on the official annual report, Mr. Charlesworth, in a speech of more than an hour's duration, drew the attention of the Fellows to systematic breakings of the fundamental rules of the society's charter by the council, and to various other subjects in which he thought that improvement might be made. He said it was a scandal to the society, with their large funds and competent income, to have advertised for a paid secretary who had the responsible duties of the care of a valuable collection and the editing of the most important publications, and to offer a salary of £200 a year, without lodging or perquisites, while even the local institutions of Bristol and York paid £250, with residences in their buildings. He said that the recent election of the present assistant-secretary by the council had been illegally done, and referred to passages in the charter as distinctly stating that the election should be made by the *Fellows* themselves; and, when some members of the council objected that the council were empowered to elect an assistant-secretary by virtue of a bye-law delegating such a power to them, Mr. Charlesworth replied by quoting other passages from the charter, "that no bye-laws could be made at variance to the rules of the charter," and he contended that therefore any such bye-law must be not only objectionable but absolutely void in law, and that any Fellow choosing to do so could, by an injunction of the Court of Queen's Bench, set aside the election altogether. He also complained that the minute-book had not been laid on the table in accordance with the rules of the society. Mr. Warington Smyth asked Mr. Charlesworth whether he wished the time of the society to be taken up by the reading of the whole of the entries relative to the council meetings for the last six months, as over that period various notices relating to the appointment had been made. Mr. Charlesworth said he wished the names of the candidates only to be read. Mr. Warington Smyth then read an extract to the effect "that the report of the committee for the election of an assistant-secretary had been received by the council," and said that that minute did not contain the names of the candidates. In reply to Mr. Charlesworth, the president said he could not remember the names of the candidates. Information on this subject was thus avoided by the council. Mr. Charlesworth then drew attention to the state of the fossils in the museum, and stated the collection was, at least as far as the finer and more delicate fossils were concerned, in a worthless state. The specimens were in drawers and covered only with paper. He alluded particularly to the valuable collection of Crag fossils presented by Mr. Searles Wood—a collection that represented the labours of a life—and the finer specimens of which were absolutely destroyed. He proposed that the Society's collection should be reduced in quantity to one-fourth, and that fourth be displayed for practical purposes in glass cases.

The officers elected for the ensuing year are:—*President*—Professor A. C. Ramsay, F.R.S. *Vice-Presidents*—Sir P. G. Egerton, Bart., M.P., F.R.S. and L.S.; R. A. C. Godwin-Austen, Esq., F.R.S.; Leonard Horner, Esq., F.R.S.; Sir Charles Lyell, F.R.S. and L.S. *Secretaries*—William

J. Hamilton, Esq., F.R.S.; Warington W. Smyth, Esq., M.A., F.R.S. *Foreign Secretary*—Hugh Falconer, M.D., F.R.S. *Treasurer*—Joseph Prestwich, Esq., F.R.S. *Council*—John J. Bigsby, M.D.; George Busk, Esq., F.R.S.; Robert Chambers, Esq., F.R.S.E. and L.S.; Sir P. G. Egerton, Bart., M.P., F.R.S.; John Evans, Esq., F.S.A.; Rev. Robert Everest; Hugh Falconer, M.D., F.R.S.; R. A. C. Godwin-Austen, Esq., F.R.S.; William John Hamilton, Esq., F.R.S.; Leonard Horner, Esq., F.R.S. L. and E.; Professor T. H. Huxley, F.R.S.; Sir Charles Lyell, F.R.S. and L.S.; Robert Mallet, Esq., C.E., F.R.S.; Edward Meryon, M.D.; John Carrick Moore, Esq., F.R.S.; Professor John Morris; Robert W. Mylne, Esq., F.R.S.; Joseph Prestwich, Esq., F.R.S.; Professor A. C. Ramsay, F.R.S.; Warington W. Smyth, Esq., M.A., F.R.S.; Alfred Tylor, Esq., F.L.S.; Rev. Thomas Wiltshire, M.A.; S. P. Woodward, Esq. The members that retired from the Council were:—Sir Roderick Murchison; G. P. Scrope, Esq.; John Lubbock, Esq.; the Earl of Enniskillen; and Sir Charles Banbury.

Manchester Geological Society.—*December 30th.*—"On the Carboniferous rocks of Shap and Crosby Ravensworth." By J. S. Bland, Esq. The rocks considered in this paper are a series of the Lower Carboniferous or mountain limestone, on the east side of the Lake Mountains in Westmoreland. These, it is well known, flank the old slate rocks of which the mountains are formed, on nearly all sides; but most regularly in the north-west, north, and north-east; running from Egremont by Brigham, Ireby, Greystoke, Lowther, Shap, Orton, to Ravenstonedale. Mr. Binney describes a portion, or section of this series, in the vicinity of Shap and Crosby Ravensworth, across to the New Red Sandstone in the neighbourhood of Appleby. The New Red Sandstone, in its turn, overlies the Carboniferous series, covering the whole of the north of Cumberland, from Maryport, around by Penrith, Ormside, to Kirkby Stephen, which is the extreme southern point it reaches. From there the line runs back by Brough, and the side of the Crossfell range, to Brampton, in Cumberland, and so northwards into Scotland.

About a mile from Shap Wells, are Wasdale Crags, the crest of a great mountain mass of porphyritic granite; flanking this, on the N. and N.E. sides, are the Lower Silurian, or green slate rocks; on the S. and S.E., are the Coniston series of flags, also considered as Lower Silurian, but of later formation; lying between these, is the Coniston limestone, described by Professor Sedgwick as running in an almost direct line from Ambleside. From the granite rocks northwards, across West Sleddale, the green slates occur; after which, as far north as Rosgill Moor, are a series of dark shaly slates, similar in character to the Skiddaw slates. In some beds Graptolites have been found by Professor Harkness. To the N. and W. again, are the green slate rocks; these, each in their position, are overlaid, unconformably by the Old Red Sandstone, or where it is wanting, by the Carboniferous series. These rocks, therefore, formed the dry land, against which the waves of the Old Red Sandstone sea made their last throws, —a wild and barren coast. The Old Red Sandstone, lying upon each of the different series enumerated, represents a coast-line, nearly at right angles to that of the Coniston group of deposits; consequently, a great change in the relative position of land and water must have taken place about the close of the Silurian era; of which, Shap granite has in this district been the disturbing power. The Old Red Sandstone from Shap Wells south to Tebay, is a considerable thickness of dark red sandstone, with conglomerates above. From Shap Wells, northwards, its position is indicated by conglomerate and red shales, evidently the deposits of an ancient shore; the best sections of it may be seen at the railway cutting at Shap summit. This cut, famous in the annals of railway engineering, is right through a hill of hard metamorphic green slate rock, which, when the Old Red Sandstone waters washed this coast, was a small peninsula or promontory of rock running out into the sea, presenting steep cliffs at low water, but nearly submerged by the higher tides. On each side of the hill, not quite to its summit, are the deposits of the old shore; first, at the bottom of the cliff, a true sandstone of only small thickness; after it, red shales and coarse conglomerates; higher still, the red colour disappears, and beds of fine gravel have been formed of the disintegrated slate and granite rocks from the neighbouring hills. This has been washed and tossed about by storms, into the crevices of the sea-cliffs, where it may now be seen, as regularly stratified as any other shingle on the coasts of the present day. This coast-line is not traceable further north. It is difficult to tell whether the upper beds of this old shore-line belong to the Old Red Sandstone, or the Carboniferous series; we may, however, admit it as marking the transition, and recording the fact, that at that time no commotion had disturbed the relative positions of land and water on this coast, such as marked the close of the Silurian era.

The first deposit in ascending order, is a limestone of considerable thickness; it is of three different characters, the lowest strata are of dun colour, the calcareous matter in a loose state of crystallization, and mixed with fine mud; the next higher division more regularly stratified, contains a large proportion of silica, containing quantities of waterworn. In the lowest division are portions of Stigmaria, Lepidodendron, Calamites, and Equisetaceæ. From the general character of this limestone, it must have been a littoral deposit from a quiet sea, subject, however, to various changes in tidal currents. The next in ascending order is a thick sandstone, the most important in quality, well adapted for architectural purposes. Above the sandstone is a limestone, of blue colour and fine texture, containing large numbers of flint nodules; the flint in some cases predominating so much as to form beds, interstratified with the limestone. These beds are prolific in Goniatites. Associated with these are innumerable Producti, on the upper surface of each stratum, lying in beds like the modern cockle or mussel. During the gradual deposit of stratum after stratum, corals of several beautiful varieties have fixed themselves to the hardened mud, or some dead shell at the bottom of the sea, and diligently erected their little temples; but they have never attained a size of more than five or six inches in height.

A slight change has now taken place in the diversity of other lands, or the sea-bottom, affecting the currents; the land has gradually risen, and we next find a deposit of a sandy composition, only a very few feet in thickness, upon which follow the innumerable beds of limestone, forming the Great Orton Scar series, of immense thickness. Its lower series partake of the character of a deep-sea deposit; but what power, and how directed, has raised them to their present high elevation, without considerably disturbing the underlying strata, is difficult to define. It forms the whole of Asby and Orton Scars, Hardendale Nab, and Knipe Scar, the highest peaks in the surrounding country, vying in height and precipitous escarpments with the old slate mountains. It may truly be termed the backbone of the area. There are many thousands of acres, known as Orton Scars, of this rock, perfectly bare, a wild barren stony wilderness, seldom relieved of its monotonous grey tone, save here and thereby the fronds of the bracken, or more delicately-shaped fern, in the crevices. It is not a plain of smooth stone, but broken up, and traversed in all directions by chasms ten or twenty feet deep, and from six to ten feet across. These are largest parallel to the strike, and are crossed at right angles by others, cutting it up into immense square blocks. in their turn broken by smaller fissures into smaller blocks; the surface stone is called the "clint" or "clint cap," which affords a good study of the way molecular attraction. or adhesion. has acted when the material forming the stone was in a viscid state. There is another set of fissures on Asby Scar, containing copper ore. In other formations of the same rock, small cracks have, by the procolation of water, often become soldered up by the crystallization of carbonate of lime. On forcing these open again, large specks of lead ore are sometimes found, a fact which, in part, may support the theory of lead being a deposit of crystallization of water. The characteristic fossils are Producti, which are very numerous, but ill preserved, and often distorted Euomphalus, Goniatites, and the black palatal bones of ganoid fishes.

Some of the limestones, and all the sandstones, in this series of rocks appear as though the material of which they are formed had settled one stratum above another, without any upheaval of the bottom of the sea, and are of one continued thickness throughout, to the outcrop; while others suggest the idea that the bottom has been gradually pushed up by some upheaving power, or that the current bringing the sedimentary matter failed to reach the outcrop, the stratum breaking off considerably further back, and the next stratum further still.

The next sandstone is very thin; above it is a thin limestone of a hard texture, in which Crinoids first became numerous; its last surface afforded a floor, on which have grown immense forests of Encrinites. Clay shale of a dark colour is next superimposed by a grey purplish sandstone, containing Stigmaria. In its uppermost beds on Harbyrn Rigg, immediately below the limestone, are beds of Pectens, and other shells. The succeeding limestone is very thin, and almost exclusively made up of broken coral; on two or three points, where it shows itself on high land, there is a stratum of coral,—clear evidence of an ancient coral reef. Next in order is a thin sandstone, generally overlaid by the next limestone: upon it rests another stratum of sandstone, associated with which are definite traces of another of the old coast-lines, exhibiting the variety of material forming a beach. The sandstone contains immense quantities of Stigmaria; at one place where a large area is laid bare, these root-like plants run in all directions, interlacing and overlapping each other in all directions, but in no case affording proof of rising into stems of Sigillaria. The calcareous and clayey deposits contain fragments of light shells and spines, of a pearly lustre, with an occasional small Trilobite; these have evidently been drifted, and quietly arranged in layers. Next is a limestone of deep-sea origin, the bluest in the series, and highly crystallized. It rises in thick large blocks, with scarcely any cleavage or natural cracks: its fossils are not numerous, but well preserved. Producti have attained their largest size; Crinoids are numerous. Upon this limestone rests a yellow sandstone, twelve feet thick,—the base of a series of shales, sandstones, and thin limestones, interstratified with which are the Reagill coal-seams. The most important of these is immediately above the sandstone, with a clay shale floor of two or three feet thick. The upper beds of the sandstone and this shale are full of Stigmaria, then follows the coal-seam, from six to twelve inches thick. We may consequently infer, that after this sandstone, with its clayey surface, became partially dry land, a rank vegetation of Sigillaria flourished, running their stigmarian roots deep into the clay and sand, till a sinking of the land brought the sea once more over it, and another deposit of clay shale six feet thick covered up the vegetable matter, gradually to be compressed and mineralized. Next above the clay shale is a hard limestone, called the ironstone; then follows another shale, with various shells, and some small Trilobites. Shales and sandstones then alternate two or three times, with sometimes a thin seam of coal, one of which is the "Crow Coal," two or three inches thick; upon these is another thin limestone of an irregular ferruginous character, affording beautiful variegated corals, Astræa and Cyathophyllum; upon it follows another sandstone, with clay shale, having a seam of coal about eleven inches thick. The coals, with their associated deposits, are of very small extent; the widest area they afford does not exceed half a mile, and, in the line of the strata, not more than four or five miles, beyond which they either have never been formed, or are overlaid. With respect to the coal formation in these rocks, as a general rule, wherever a clay shale is found lying on a sandstone, it is possible to find in the shale a trace of coal varying from a mere mark to twelve or thirteen inches. It is worthy of notice that the shales resting upon limestone are invariably full of animal- and destitute of vegetable-remains, while those upon sandstones are destitute of animal-remains.

We now cross a series of red-coloured limestones, formed in a great measure of Encrinitic fragments. Upon the first of these rests a grey sandstone, followed by limestone; a sandstone follows, the thickest in the series, and, from its general character, of deep-sea origin. The limestone overlying it, one of the thickest and most important, is the last of its race, for upon it rests the New Red Sandstone. These two may be traced all through this and the sister-county; in many places they are almost the only representatives of the Lower Carboniferous era, having either totally overlaid the others, or they have never been deposited. The Morland limestone, does not, however, immediately follow the thick sandstone, for between them, in the neighbourhood of Morland and King's Meaburn Scar, there may be found a thin limestone and sandstone. The limestone is of a deep red colour, and with the red clay shale above it, is perhaps the richest and most prolific in fossil remains of any. It is certainly a shallow-water deposit. Its upper beds are the site of a very luxuriant forest of crinoids; these are very numerous in the shales, and some may be found with the root attached in their original positions. Associated with them are quantities of the Fenestella, beautifully preserved, shells innumerable on every layer, and very frequently remains of small Trilobites. Thus, these animals range through the whole of this series, but are only found in deposits of a coast or shallow-water origin. The sandstone above is decidedly an ancient shore, or sandy beach. What the inhabitants of the land were, these rocks have afforded no record; but of the sea, the most gigantic form of animal life was the Orthoceras. These are numerous in the upper red limestones, varying in size from two to four and a half feet in length, perhaps the most gigantic size they have ever attained, and doubtless at that era they were lords of the sea.

The lower beds of the New Red Sandstone are the next rocks upon the Morland limestone. These, in the southern extremity of the basin, are breccias, of great thickness, followed by true sandstone. These, according to Professor Harkness, belong to the Permian; they encroach or recede from the outcrop of the Morland limestone, as the level of the country has permitted, but in no case are they overlaying it.

Having given the characteristic features of each rock, in the order of its deposit, the author gave an outline of the position they occupy, and of the forces he conceived to have been at work. It has been said the Old Red Sandstone lies unconformably upon the metamorphic slate rock: what its angle of dip might be the author could not say, but it is probably the same as that of the carboniferous rocks, which, as a general rule, is one in ten, or an angle of 5° rising S.W. and dipping N.E. In some places the angle is greater, as on Hardendale Fell and Nab, while in others they are almost horizontal, showing that agencies have been at work, irregularly heaving and lowering, throughout the long period of their formation. As a general rule, deposits made by water are laid horizontally; whence then the inclined angle at which these rocks now lie? There is no certain evidence of any upheaving power having caused it on the west side, but the disturbance is to be found on the east. Crossing over the basin in which is the New Red Sandstone, we come to another series of carboniferous rocks, similar to those enumerated, in being made up of limestones, sandstones, with coal seams, and clay shales, but with this difference, that they form a high mountain-range, known as the Crossfell Range. If we examine these in the lower series, we find first the Silurian as the lowest or Skiddaw slates traceable, with few exceptions, for many miles. Above it is a conglomerate of quartz, pebbles, and coarse grit, near Knock Pike, which on Roman Fell is the true Old Red Sandstone; next in ascending order are the carboniferous rocks, the lowest a limestone of a reddish colour, then a thick shale, followed by a sandstone, to be seen near Howgill Castle; this is again superimposed by a limestone, measuring 120 feet in thickness, and in many respects similar to the before-mentioned Morland limestone. This is traceable up to the middle of Crossfell, and immediately upon it rest the varied strata of millstone grit. To the south, however, along the same range, it is followed by a series of limestones, sandstones, coal, etc., and in one case a layer of basalt twenty-four yards thick, which has been overlaid. These are in the Dufton mining-district, where the Morland limestone is the chief lead-bearing stratum. From the top of this range, in the direction of Alston, may be crossed the strike of many different rocks, up to the last of the true coal-measures in Durham. After the formation of the last limestone in the valley, we see that the laws of nature have still gone on, raising and lowering the land, while the sea has continued to deposit other series of rocks, one upon another, each in its turn becoming dry land, and so on till the last of the coal-formations. Then comes a great convulsion, when a mighty crack has rent the hard surface of the earth from north to south, many miles in length, and now known to geologists as the Crossfell Fault; the effect of which has been to raise the east side into the high mountain-range of Crossfell; and to lower the west side, and form the rich basin of the Vale of Eden. So much has been done, between raising one side and lowering the other, that the Silurian and Old Red, which are found at Shap Wells and on Raftland, have been brought to light, the distance between these, from the formations *in situ* at Shap, to the fault at Crossfell, being about ten miles direct; and the dip being about one in ten, these strata at present would be about a mile deep; so the upheaval on the one hand, and depression on the other, may be probable causes of the dip we now find.

"The volcanic rocks causing this disturbance, may be found, at the bottom of Knock Pike, as a granite, pushing up a cone of greenstone; also Dufton Pike as a micaceous porphyry; and Murton Pike similarly. At the time of this great disturbance, as the level of the one side was lowered, the New Red Sandstone sea rushed over the sunken country, from the north, tearing and rushing with a mighty force; breaking up into fragments the old-deposited limestone, and mingling with the heterogeneous mass a matrix of red sand, etc., in which way we may, in all probability, account for the immense masses of breccias resting upon the older strata, in the southern extremity of the New Red basin. The red sand brought by this

as overlaid the intervening valley so much, that, on the Crossfell
u may almost step from the New Red to the section of the Old. The
om which were deposited these rocks, eventually withdrew, and our
· was then added to that dignified portion of the earth's surface,
Dry Land;' which it maintained throughout the long ages of the
, Cretaceous, and Tertiary periods, subject to the wear and tear of
, and the convulsive throes of earthquakes, till Divine Providence
d the icy sea of the Drift era, to cover its naked surface with a coat
'el, sand, and clay." It may be here remarked, that the shocks of
uakes are not unknown even at the present day. So lately as the
ıg of the 6th of last December, this district was visited by a very
e convulsive quiver.

ety of Arts.—*17th December.*—"On Mines, Minerals, and Miners
United Kingdom." By Robert Hunt, Esq., F.R.S., of the Govern-
School of Mines. A valuable paper full of important details. It has
printed by Professor Tennant from the 'Society of Arts Journal,'
tuitous distribution.

hropological Society.—This society, founded on the 6th of Janu-
t, already numbers 120 members, and has commenced its meetings.
been formed with the object of promoting the study of Anthropo-
a strictly scientific manner; to study man in all his leading aspects,
l, mental, and historical; to investigate the laws of his origin and
ss; to ascertain his place in nature and his relations to the inferior
of life; and to attain these objects by patient investigation, careful
on, and the encouragement of all researches tending to establish a
o science of man. Many of the researches undertaken by this so-
ill fall legitimately within the provinces of Geology and Archæology.
llowing Council has been appointed:—*President*—Dr. James Hunt,
, F.R.S.L., For. Associate Anthropological Society of Paris, etc.
Presidents—Captain Richard F. Burton, H.M. Consul at Fernando
.; Sir Charles Nicholson, Bart. *Honorary Secretary*—C. Carter
Esq. *Honorary Foreign Secretary*—Edward B. Tylor, Esq. *Ho-
Assistant Secretary*—Alfred Higgins, Esq. *Treasurer*—R. S.
ck, Esq., F.S.A., F.R.G.S. *Council*—Rudolph Arundell, Esq.;
. Blackstone, Esq., M.A., F.R.G.S.; W. Bollaert, Esq., F.R.G.S.
Mem. Univ. Chile and Ethno. Socs., London and New York; Luke
Esq., F.E.S.; J. F. Collingwood, Esq., F.G.S.; G. D. Gibb, Esq.,
F.G.S.; J. Hughlings Jackson, Esq., M.D., M.R.C.P.; S. J.
, F.G.S., F.S.A., F.E.S.; Edward Pick, Esq., F.E.S.; T. S. Pri-
Esq.; William Travers, Esq., M.R.C.S.; W. S. W. Vaux, Esq.,
F.S.A., F.R.S.L.

NOTES AND QUERIES.

ficial Cavern.—A cave has been lately discovered in New Hamp-
America), whence the Indians of New England are supposed to
otained their arrow-heads and flint-instruments. The cave is an
l excavation, twenty-eight feet long, twelve wide, and eight or ten
ith a narrow mouth, in a jasper vein enclosed in "granite," of a
ountain-spur on the banks of the Androscoggin, one and a half
om Berlin Falls.

× European area. † N. American. o S. American. * African. ‡ Asiatic. § Australasian.

Species.	Alluvial.	Diluvial.	Caverns.	Pleistocene.	Pliocene	Miocene.	Eocene.	Maestricht.	Chalk.	Localities, Authorities, and References.
I. RAPTORES.										
1. *Diurni.*										
Cathartes							?			*Terrain d'eau douce*, Dép. du Cantal, Jourdan, Institut, 1837, p. 343.
——			o							*Caverns* (with *Megatherium*), Brazil, Lund, München Gelehrte Anzeigen?; Gervais, Thèse, p. 31.
Lithornis vulturinus							×			*London Clay*, I. of Sheppey, Owen, Trans. Geol. Soc., 2 ser. t. vi. p. 206, and Brit. Foss. Mammalia and Birds, p. 549.
Vultur cinereus		×								*Diluvium*, Magdeburg, Wagner, Abh. Bay. Ac. p. 773; *V. fossilis* = Germar in Lethæa, t. ii. p. 824; Giebel, Fauna der Vorwelt, t. i. 2ᵉ part, p. 9; *Breccia*, Sardinia, Della Marmora, Journ. de Géol. t. iii. p. 313.
Nisus			×							*Caverns*, S. of France, *Caverns* of Sallèle and Bize, M. de Serres, Journ. de Géol. t. iii. p. 262.
Falco					×					*Pliocene*, Montpellier, Gervais, Zool. et Pal. Franç., p. 220.
——										*Cavern* (Berry Head), Torbay, Owen, Brit. Foss. Mamm. and Birds, p. 558.
Buteo			×							*Caverns*, Dép. de l'Aude, M. de Serres, Institut, 1842, p. 388.
——		×								*Breccia*, Sardinia, Wagner, Neues Jahrbuch, 1833, p. 334; Giebel, F. der Vorwelt, t. i. 2, p. 9.
Aquila		×								*Breccia*, Sardinia, Nitzsch, Neues Jahrb. 1833, p. 324; Giebel, F. der Vorwelt, t. i. 2, p. 9.
Pandion							×			*Gypsum*, Paris (*Parisien supérieure*), Cuvier, Ossemens Fossiles, t. v. p. 577.
2. *Nocturni.*										
Strix (s.-gen. *Ulula*)							×			*Gypsum*, Montmartre, Cuvier, Ossem. Foss.; Giebel, Fauna der Vorwelt, t. i. 2, p. 11.
——		×	×							*Cavern*, Nabrigas; *Diluvium*, Kostritz; Bibliothèque Universelle, 1835; Archives, t. xviii. p. 349; Isis, 1829, p. 739.
——			o							*Caverns*, Brazil, Lund, Institut, 1844, p. 291.
—— nyctea?		?								*Breccia*, Sardinia, Nitzsch, Neues Jahrb. 1833, p. 324.
Bubo			×							*Caverns*, Dép. de l'Aude, M. de Serres, Institut, 1842, p. 388.
II. INSESSORES.										
Protornis Glariensis							×			*Glaris slate*, Plattenburg, H. v. Meyer, Neues Jahrb. 1839, p. 682: 1840, p. 211; 1841, p. 187; 1844, p. 388.
1. *Dentirostratæ.*										
Motacilla		?								*Breccia*, Cette, Wagner, Abh. Bayer. Acad. 1832, p. 751.
Turdus Bresciensis		?								*Breccia*, Cette, Wagner, op. cit.
——		×								*Breccia*, Sardinia, Wagner, Neues Jahrb. 1833, p. 772; *Breccia*, Nice, Wagner, Abh. Bay. Ac.

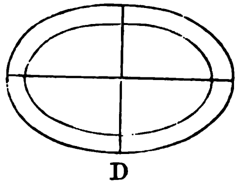
—— crassipennis		×								*Diluvium*, Quedlimbourg, GIEBEL, Fauna der Vorwelt, i. 2, p. 16.
—— corone? vel corax?		×	×							*Diluvium*, Valley of the Lahn; H. v. MEYER; *Breccia*, Sardinia, WAGNER, Abh. Bayer. Acad. 1832, p. 751; *Cavern*, Kirkdale, BUCKLAND, Reliq. Diluv.
—— pica?			×							*Cavern*, Brengues, PUEL, Bull. Soc. Géol. de Fr. 1837, p. 43; Kirkdale, BUCKLAND, Reliq. Diluv.
4. *Tenuirostratæ.*										
Dendrocolaptes			o							*Caverns*, Brazil, LUND, Münch. Gel. Anzeig. 1842, p. 886.
III. SCANSORES.										
Picus martius		?								*Breccia*, Sardinia, WAGNER, Abh. Acad. Bayer. 1832, p. 751.
Coccyzus		o								*Caverns*, Brazil, LUND, Münch. Gel. Anzeig. 1841.
Capito		o								} *Caverns*, Brazil, LUND, Münch. Gel. Anzeig. 1842.
Psittacus		o								
IV. VOLITORES.										
Cypselus collaris			o							*Caverns*, Brazil, LUND } Münch. Gel. Anzeig. 1842, p. 886; GERVAIS, Thèse, p. 34.
Caprimulgus			o							*Caverns*, Brazil, CLAUSSEN }
Halcyornis toliapicus							×			*London Clay*, Isle of Sheppey, OWEN, Brit. Foss. Mammalia, p. 554.
V. RASORES.										
1. *Gemitores.*										
Columba			×							*Caverns*, Kirkdale, BUCKLAND, Reliq. Diluv.; MARCEL DE SERRES, Journ. Géol. t. iii. p. 362.
Didus ineptus	*	?								} *Alluvium* (et *Diluvium ?*), Bourbon and Mauritius, STRICKLAND and MELVILLE on the Dodo.
Pezophaps solitaria	*	?								
2. *Clamatores.*										
Tetrao		×	×							*Diluvium* and *Caverns* of Brengues, PUEL, Bull. Soc. Géol., vol. ix p. 45.
Coturnix?								×		*Gypsum*, Paris, CUVIER, Ossem. Foss., 4e édit. t. v.
Perdrix							×			*Miocene*, Weisenau, GIEBEL, Fauna der Vorwelt, i. 2. p. 22; *Miocene*, Auvergne, GERVAIS, Thèse, p. 22.
——		×	×							*Caverns*, Liége, SCHMERLING; Bize, MARCEL DE SERRES, Journ. Géol. t. iii.; Kirkdale, BUCKLAND, Reliq. Diluv.; *Diluvium*, Valley of the Lahn, H. v. MEYER.
——			o							*Caverns*, Brazil, LUND, Münch. Gel. Anzeig. 1842.
Phasianus		×	×							*Cavern*, Bize, MARCEL DE SERRES; *Diluvium*, Paris, GERVAIS, Journ. Géol. t. iii. p. 263; Institut, 1844, t. xii. p. 293.
Gallus							?			*Molasse* du Mont de la Molière, GERVAIS, Thèse, p. 27; *Sable Tertiaire*, Auvergne.
—— Bravardi							?			*Miocene ?* Ardé, GERVAIS.
—— domesticus?		×	×							*Caverns*, Lunel-Viel, MARCEL DE SERRES, op. Lunel-Viel; Liége, SCHMERLING; *Diluvium*, Kostritz; Valley of the Lahn, H. v. MEYER.
Numida		?								*Loess*, Sasbach, H. v. MEYER.
Tinamus			o							*Caverns*, Brazil, LUND, Münch. Gel. Anzeig. 1842.

× European area. † N. American. o S. American. * African. ‡ Asiatic. § Australasian.

Species.	Alluvial.	Diluvial.	Caverns.	Pleistocene.	Pliocene.	Miocene.	Eocene.	Maestricht.	Chalk.	Localities, Authorities, and References.
VI. CURSORES.										
1. *Apteryx*, 2sp. (? the same as the recent *A. Mantelli*, *Oweni*, or *australis*)	?									
Rhea			o							*Caverns*, Brazil, Lund, Münch. Gel. Anzeig. 1842
——			o							
Dinornis giganteus	§	?								*Alluvium* and *Diluvium* ?, New Zealand, Trans. Zool. Soc. vol. iii. and vol. iv. etc.; Mag. Nat. Hist. vol. xii. p. 444, etc.
—— struthioides	§	?								
—— didiformis	§	?								
—— curtus	§	?								
—— crassus	§	?								
—— rheides	§	?								
—— casuarius	§	?								
—— otidiformis	§	?								
—— elephantopus	§	?								
—— robustus	§	?								
Palapteryx ingens	§	?								
—— dromioides	§	?								
—— geranoides	§	?								
Aptornis	§	?								
Æpyornis, Eggs from Madagascar and bones	?	?								*Alluvial*, Isidore Geoffroy, Compt. Rend. Ac. des Sc. 27 Janvier, 1851.
Moa	§									*Alluvial* and *Recent*, N. Zealand. Eggs, W. Mantell, Athenæum, 25 Sept. 1847; Bibliothèque de Genève, Archives, t. vi. p. 266.
Lithornis? emuinus								×		*London Clay*, Isle of Sheppey, Bowerbank, Annals Nat. Hist. (1851) and Rep. Brit. Assoc. 1851, Sect. p. 55.
Gastornis Parisiensis										*Lower Eocene*, Meudon, near Paris. Owen, Geol. Soc. Journ. vol. xii. p. 204, pl. 8. f. 1.
VII. GRALLATORES.										

3. *Longirostratæ.*		×							… Journ. Geol. t. iii. p. 31[illegible]
Numenius gypsorum							×		*Gypsum*, Montmartre, GERVAIS, Thèse, p. 18; CUVIER, Ossem. Foss., 4e édit. t. v. p. 597, pl. 154, fig. 14 = *Tantalus fossilis* auctorum.
Scolopax ?							×		*Gypsum*, Montmartre, GERVAIS, Thèse, p. 18.
——— —						×			*Miocene*, Weisenau, H. v. MEYER, Neues Jahrb. 1843, p. 398.
——— ?					×				*Pliocene*, Oeningen, BLUMENBACH, Spec.; KARG, Denks.; GIEBEL, F. der Vorwelt, i. 2, p. 28.
———			×						*Cavern*, Kirkdale, BUCKLAND, Reliq. Diluv.; *Tuf diluvien*, Meissen, GIEBEL, Fauna der Vorwelt, i. 2, p. 28.
——— ?								×	*Greensand* (*Senonian*), New Jersey, HARLAN, Phys. et Med. Res., p. 280.
Pelidna ?							×		*Gypsum*, Montmartre, CUVIER, Ossem. Foss., 4e édit. t. v.; GERVAIS, Thèse, p. 18.
Tringa ?							×		*Gypsum*, Montmartre, GERVAIS, Thèse, pp. 16 and 18.
4. *Macrodactyli.*									
Fulica ?						?			*Lignites*, Kaltennordheim, SCHLOTHEIM, Petrefacten, p. 26; GIEBEL, Fauna der Vorwelt, p. 29.
Rallus		?							*Breccia*, Montmorency, C. PREVOST et DUNOYER, Institut, 1844, t. xii. p. 293.
——			o						*Caverns*, Brazil, LUND, Münch. Gel. Anzeig. 1842.
Notornis Mantelli	×								*Alluvium*, New Zealand, OWEN, Trans. Zool. Soc.; MANTELL, Ann. Nat. Hist. 1850; Bibl. Univ. 1851; Archives, t. xvi. p. 73.
VIII NATATORES.									
1. *Longipennatæ.*									
Larus priscus		×							*Diluvium*, Quedlimbourg, GIEBEL, Fauna der Vorwelt, i. 2, p. 31.
—— sterna ?		?							*Breccia*, Nice, WAGNER, Abh. Bay. Acad. 1832, p. 772.
2. *Totipalmatæ.*									
Pelicanus							×		*Gypsum*, Montmartre, CUVIER, Ossem. Foss., 4e édit. t. v. p. 596.
Phalacrocorax						?			*Tertiary* (*Palustral Limestone*), Monbach, GIEBEL, Neues Jahrb. 1839, p. 70, and Fauna der Vorwelt, p. 33.
3. *Lamellirostratæ.*									
Cygnus olor ?			×						*Caverns*, Lunel-Viel, MARCEL DE SERRES, DUBREUIL, et JEAN-JEAN, op. Lunel-Viel.
——— ferus									*Pliocene*, Grays, Essex, OWEN, Geol. Soc. Journal, vol. xii. p. 211, pl. 3, fig. 13.
Anser		×							*Diluvium*, Lawford and France, BUCKLAND, Rel. Dil.; GERVAIS, Thèse; GIEBEL, F. der Vorwelt.
Anas						×			*Tertiary*, Auvergne, GERVAIS, Thèse, p. 24.
——		?							*Breccia*, Sardinia, WAGNER, Abh. Bayer. Acad. 1832, p. 751.
——		×	×						*Diluvium*, Valley of the Lahn, H. v. Meyer; *Cavern*, Kirkdale, BUCKLAND, Reliq. Diluv.
Colymbus			×						*Cavern*, Kirkdale, BUCKLAND, Reliq. Diluv.
Mergus Ronzoni						×			*Lower Miocene*, Ronzon, near Le Puy, GERVAIS, Thèse, p. 22 (=*M. serrata*).
BIRD-BONES *incerti sedis.*									
Palæornis Cliftii									*Wealden*, Cuckfield, Mantell, Geol. Trans., series ii. vol. v. pl. 13, fig. 6; Wonders of Geology, 6th ed. p. 442, and 7th ed. p. 453.
?									*Greensand*, Cambridge, discovered by LUCAS BARRETT.
?									*Lower Eocene*, Woolwich beds, Counter Hill, PRESTWICH, Q.J.G.S., vol. x. p. 157; also in Woolwich beds, near Sydenham (Mr. Wakes' collection).
?									*Stonesfield slate*, *fide* the Rev. J. DENNIS.

NOTE ON A PROGRESSIVE CHANGE IN THE FORM OF THE EA
If it be assumed that the earth has cooled to its present temperatur a state of incandescence, it will follow that its form is subject to progressive change. Let A C B D be the spheroid of equilibrium epoch, the form of this spheroid depends on its magnitude and the v of rotation. If either of these changes, the form will change. N



the spheroid A C B D contract, by c to the spheroid *a c b d*, whose surfac be considered as parallel to A C B D; the amount of contraction is small, th B *b* is equal to C *c*. If these equals b from both terms of the ratio O B : O ratio will be increased; therefore O is greater than O B : O C; that is, the torial diameter has a greater ratio polar diameter than it had before th traction took place. The effect of this is equivalent to a constant mulation of matter at the equator in *excess* of what is due to the v of rotation. This excess could never attain to any considerable mag so long as the earth was in a fluid state, as the change would tak *per gradum* from the old to the new spheroidal form of equilibriun when the external crust became sufficiently rigid to oppose resista the change of form, the alteration would take place *per saltum* weakest points. This is probably worthy of the attention of those wh the necessary qualifications for discussing mathematically the diffic intensely interesting subject—the physical causes of geological phen To those who feel a difficulty in understanding how contraction t the centre can produce upheavals *from* the centre, I recommend t lowing experiment. Fuse a bead of carbonate of soda in the bl flame. Dip the bead into a little powder of silex and fuse again. the cooling through a magnifier. Conical hills start up and mo chains are formed as if by magic. The experiment may be repeat number of times with the same bead, which proves that the elevatio not caused by escaping carbonic acid gas, but by the contraction of t ternal cooling surface on the internal fluid mass.—G. H.

MAMMALIAN REMAINS IN THE HAMPSHIRE GRAVEL.—Sir,—In th ber of your periodical for November last, p. 427, you were good eno publish a communication from me, from which it might be inferre my inquiries for animal remains, in the gravel deposits of this neig hood, had been fruitless.

I have since, however, by inquiring of gravel-diggers, been ma quainted with, and have to-day seen, a molar tooth of an elephant fr gravel at Swathling, which is a village about three miles east of this This is the only instance of the kind in this neighbourhood with w am acquainted; but I remember meeting somewhere with the men the existence of mammalian remains in the gravel at a locality at th of the Isle of Wight: perhaps you might be able to tell me if th any other such fossil-bearing spots, in the gravel, recorded as exis the county of Hampshire?

I was likewise shown to-day a bunch of sea (?) shells from the also from the neighbourhood of Swathling, but from a different loc where the first-mentioned fossil was found. W. T. NIC

Southampton, February 9, 1863.

NEW SPECIES OF FISH FROM THE CRAG.—Dear Sir,—I belie up to the present time the remains of Placoid fish only have been f the Red Crag of England. It is, therefore, a matter of importance to add fish of any other groups to its fauna. A friend of mine received last year, from Aldborough, in Suffolk, a hardened slab of crag, containing a portion of the vertebral column and fins of a fish, which certainly did not appear to belong to any of the forms before known. It was shown to Professor Huxley, who affirmed that it was in too imperfect a state of preservation to warrant any decision as to its genus or species. Sir Philip Egerton likewise saw the specimen, but would not venture to say more than Professor Huxley. My friend then took his specimen to Dr. Günter, of the British Museum, who is intimately acquainted with recent species of fish; after a close examination of the specimen, he came to the conclusion that, judging from the position and form of the fins, the fish to which they belonged was probably closely allied to the common cod (Gadus); but from the absence of any skull-bones, and its generally imperfect state of preservation, it was impossible to speak with more certainty. I enclose you a sketch of the specimen, which measures nearly a foot in length. It is to be hoped that geologists visiting the neighbourhood of Aldborough will take the opportunity to make a close examination of the hardened slabs of crag, which are, I believe, abundantly scattered on some parts of the shore; and I trust that it will not be long before further specimens are obtained, which will throw more light upon the nature and affinities of the fish-remains in question.

I should observe that there is no doubt as to the specimen being derived from Crag strata, as the block contains impressions of various well-known crag fossils; among others, I may mention *Emarginula fissura*, which, I believe, does not range lower than the Crag. Truly yours, E. R. LANKESTER.

8, *Savile Row, February* 6, 1863.

FLINT IMPLEMENT NEAR NORWICH.—Sir,—Though recent discoveries have made it difficult to say where geology ends and archæology begins, I cannot but feel that my present communication belongs rather to the latter than the former branch of science; nevertheless, I shall be glad if you can find a place for it in an early number of the 'Geologist.'

I was walking, on Saturday, Jan. 18, 1862, from Norwich to Caistor, an extensive Roman encampment about four miles south of the city, and observed, at various places on the road, heaps of flints intended for road repairs. They appeared to be of three kinds, or, more correctly, derived from three sources, viz.:—

1st. Those recently extracted from the chalk of the district.

2nd. Those taken from the supracretaceous gravel-beds.

3rd. Those which had been picked off the neighbouring fields, where they had been turned up by the plough or harrow.

So far as I could judge, the three classes were kept separate, that is, each heap appeared to consist of one kind only.

At about two miles and a half from Norwich my eye casually rested on a flint, which I believed to be an "implement," lying on a small heap of the third kind; and, on stepping back, my first impression proved to be correct, as I took up the "implement" I now send you.

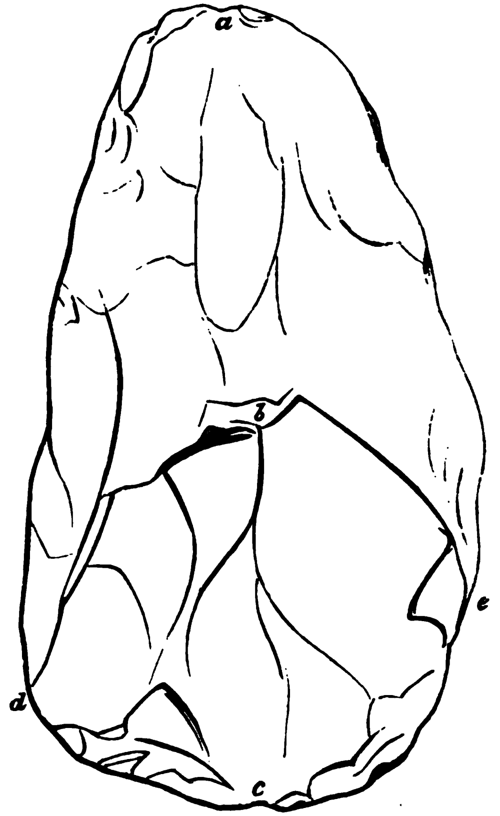
I endeavoured to discover its "trail," but without success. The workmen assured me they had never found anything of the kind in the gravel-beds, or indeed anywhere. The object was evidently new to them. They were of opinion that it had been "ploughed up," and picked off the ground with other stones for road repairs. The Rev. Mr. Gunn subsequently informed me that it is the only specimen of its type which has been found in Norfolk.

You will observe that it has several iron stains, especially at some of the edges and angles, and also that it has some slight traces of polish;

consequences and proofs, probably, of the treatment it has endured since its deposition.

Mr. Evans, of Hemel Hempstead, to whom I some time since submitted it, has been so kind as to send me the following opinion respecting it:—

"I have examined it carefully, and the conclusion to which I arrive is that it does not belong to the 'Drift period,' but that it must be classed



Flint Implement from between Norwich and Caistor.

among the implements of the so-called 'Stone period.' The general form is very much that of the ordinary stone 'celt,' adapted for cutting at the broad end; a portion, however, of the edge has been broken or worn away. I am not sure whether there are not some traces of its having been ground on some parts of its surface.

"Judging from the appearance, I should say that the 'celt' had been lying upon or near the surface for a considerable time, in rather a sandy soil. It seems to be altered superficially to a considerable depth, and the numerous rusty marks upon it testify to its having frequently been brought into contact with the plough and harrow, whose rude assaults its tough constitution has enabled it to withstand."*

* Extract of a letter from John Evans, Esq., F.S.A., F.G.S., June 18th, 1862.

It seems desirable to place on record the discovery of specimens like the ove, even though they may add nothing to the evidence on the question human antiquity.—I am, yours, etc., WM. PENGELLY.

Lamorna, Torquay.

[The implement which I have drawn above, from the specimen kindly forwarded to by Mr. Pengelly, appears to me to present the singular appearance of having been nufactured out of one of the large pointed implements of the Drift of the Amiens and ine pattern. All the portion from *a*, *d*, *b*, *e*, *a*, is smoothed by wear or friction, ile the lines of fracture in the remaining portion, *d*, *b*, *e*, *c*, *d*, are sharp and fresh, of sequent workmanship, but not of recent fabrication.—ED. GEOL.]

MAMMALIAN REMAINS AT DULWICH.—In the 5th volume of the 'Geogist,' page 302, Mr. A. Bott announced the discovery of the tooth of a ammalian animal from the Woolwich beds near Dulwich.

Since the publication of that notice, Mr. Bott has kindly placed at my sposal a most accurate and beautiful photograph of the tooth in question. regret very much that a careful examination of it does not permit me to cide with any certainty on the generic position of the animal to which it longed. I consider the tooth in question to be a canine; and after a mparison between it and the *Coryphodon* of the Lower Eocene of England and France, think it highly probable that it may have belonged to at genus. The identification, however, of any species of herbivorous ammal by means of one solitary canine tooth is exceedingly to be deecated.—C. CARTER BLAKE.

EXTENT OF THE DRIFT.—The low country in the east of England, north the Thames, and all Wales, is more or less covered with drift; but the uth of England, the Wealden area especially, and the country south of e Bristol Channel, is in general destitute of it, except at very low vels on and near the shore at Brighton, Selsey Bill, etc. On both sides the valley of the Firth, and inland over the whole of Scotland, there are imerous indications of glacial action, both in the older boulder-clay, avel, and later boulder-clay and gravels that more or less cover the untry, and in the frequent striation of the rocks visible where the drift s been freshly cleared. By the Firth Professor Ramsay has observed ese striations to run roughly from east to west in the main line of the lley; and north of the Grampian mountains, Professor Jamieson states at they generally follow the great slopes of the country on the east and st sides of the chief watershed. These striations, Professor Ramsay inks, were probably formed at a time when the whole country was cased ice, like the north of Greenland at the present day, and during the period which the older boulder-clay was formed. This was afterwards suberged, and the younger drift deposited; and on the re-emergence of the nd, a second set of glaciers, of smaller size, filled many of the valleys.

From the great Laurentian chain to the banks of the Ohio, the central ains of North America are more or less covered with boulder-clay and ift, often several hundreds of feet in thickness. When removed, the rocks which those deposits rest are found to be very generally grooved and riated; the striations running more or less from north to south. Exples are everywhere to be met with in that region; but these occurnces have been more especially described near the Falls of Niagara, on e shores of the Hudson, the eastern flanks of the Catskill Mountains, d along the side of the escarpment from north to south up to the high nor gorge that traverses the range from east to west; and by Mountain ouse, nearly 3000 feet above the sea, the striations bend round and cross watershed, as if, according to Professor Ramsay, when the land was merged to a certain level, the ice, previously grating along the side of the escarpment, had found a passage to the west, through what is now an upland valley.

Bone-Cave at Cefn, Flintshire.—Cefn Cave was first explored by the Rev. Edward Stanley, late Bishop of Norwich, in 1832. It lies in the carboniferous limestone of Denbighshire, near St. Asaph, in the Vale of Cyffredan, on the west side of the Vale of Ebwy. It is on the side and near the top of a steep escarpment overlooking the river. Most of the bones were probably dragged in by beasts of prey, of which it served as the den; others may have dropped in through cracks in the roof. The following species, named by Dr. Falconer, have been observed; many of these were in the possession of Lieut.-Colonel Watkins Wynne, on whose property the cave lies:—*Elephas antiquus*, *Rhinoceros hemitœchus*, *Rhinoceros tichorinus*, *Hippopotamus major*, *Bos*, *Cervus*, etc. No human remains have been found in it, but human bones have been found at a lower level in the base of the same escarpment. In the Vale of Clwyd there is much stratified drift, with ice-scratched boulders and sea-shells; and Professor Ramsay says the cave has clearly been submerged during the glacial or drift period, as he and Dr. Falconer have found fragments of cockles and other marine shells in the clay, and amongst the gravel and stones with which it is filled.

Peat Sandstone.—Dr. Mega states, in 'Hameberg's Journal,' that there occurs in the heaths of Hannover (America) a kind of moss-bed pan, which consists of sand cemented by peat; though, on account of its colour, it is generally thought to be either bog-iron or iron-sandstone. It is formed by the evaporation of bog-water from a nearly pure quartz sand. The grains of sand first acquire a yellow, then a brown, and finally a dark brown or black colour. When the peat solution evaporates, the peat is left in a form no longer soluble in water. It gradually fills up the interstices of the sand, and makes an impenetrable mass possessing a good degree of hardness and tenacity. When this peat sandstone is placed in ammonia a dark solution of humic acid is obtained, and nothing but white sand remains.

Copper Age of America.—M. Morlot has drawn attention to this topic. He says:—Some more light seems to be thrown on the date of the "Copper Age" by the fact recorded in Schoolcraft's 'Indian Tribes' (vol. i. p. 133). Twelve miles from Dundas, Canada West, there were discovered, about 1837, extensive ossuaries, and among the bones were found amulets of the red pipestone of Coteau des Prairies (Minnesota), copper bracelets like those of the old graves in the West, a *Pyrula spirata* and a *P. perversa*, both from the Gulf of Mexico, four antique pipes used without stems, and corresponding with an antique pipe from an ancient grave at Thunder Bay, Michigan, a worked gorget of sea-shell, with red nacre and shell-beads of the same kind as those said to have been found in the gigantic mound of Grave Creek, Virginia. All this goes to characterize the ossuaries of Beverley as belonging to the time of the mound-builders—that is, of the "Copper Age." But these ossuaries have also yielded some beads and baldrics of glass and coloured enamel (figured by Schoolcraft, pl. xxiv. and xxv.). This find is not single in its kind, for according to Schoolcraft ('Lead Mines of Missouri,' 2nd part, 1819), beads agreeing completely with those of Beverley were found in 1817 in antique Indian graves, at Hamburg, Erie county, New York. Schoolcraft distinctly points out the beads as of European origin. This M. Morlot thinks unquestionable, as the native industry of America never produced glass or enamel; and he further states that similar beads have been obtained in Sweden, and Denmark, and Germany. These beads are not, according to Minutoli's paper

›n the Stained Glass of the Ancients' (Berlin, 1836), of Roman origin, d are found in old Etruscan graves; also in Egypt, where they may ve been manufactured at Alexandria before the Christian era, perhaps far back as the olden times of the Phœnicians, who were celebrated for eir glass-ware as well as for their commerce and their extensive navigation. e discovery of America by the Phœnicians has been strongly suspected many, and it would account, in M. Morlot's opinion, in a very natural anner for the tradition of the Atlantis. The fact is in itself, he thinks, r from improbable, when we reflect that long before the Christian era e Alexandrian astronomers knew the earth to be round, and that one of em, Eratosthenes (third century before Christ), calculated the circumference of the earth with a surprising degree of accuracy. The find at verley, then, goes to show, M. Morlot conceives, that a given moment ' the American "Copper Age" coincided with a given moment of that uropean civilization to which the enamelled beads belonged and which uld hardly reach lower down than the Christian era, while it appears to o as far back as five or even ten centuries earlier. Of course, it is not to e understood that the American "Copper Age" was wholly parallel ith the Phœnician period. It may have begun sooner, and may have sted later; but, if this view be correct, there is thus, by indirect means, chronological determination for the North American "Copper Age," ar from precise, but which further discoveries will correct.

ARGYLLITE.—A new mineral under this name was described in a late umber of Newton's 'London Journal of Arts,' by Mr. Lewis Thompson. For some years past, a nickel mine has been worked on the estate of the Duke of Argyle, at Inverary, and from time to time borings have been ade to discover the extent of the vein, and, from amongst the different inds of minerals thus obtained, one sample was found by the Duke to ossess the power of reflecting light. The mineral was found in very mall quantities, but curiosity being excited to know what it was, a porion was sent to Mr. Thompson for analysis. He asserts it to be a compound of lead, vanadium, and sulphur—a combination that he says has ever before been noticed. The crystals are very small and by microcopic examination were found to be 12-sided, or dodecahedrons. This iscovery recalled to Mr. Thompson's recollection a peculiar kind of opper-ore he had obtained many years ago from near Fowey, in Cornwall. This ore had always to be melted by itself in Swansea, and the copper obained from it could not be rolled in sheets. The cause of this was not xamined into at that time; but as the ore contained well-formed crystals, esembling galena mixed with copper, Mr. Thompson suspected it might e the same kind of ore as that obtained at Inverary. Specimens of this Fowey ore have now been subjected to careful analysis, and found to contain—lead, 60·8; vanadium, 20·5; sulphur, 18·7=100. The specific gravity is 6·04; the colour a dark lead-grey, with considerable lustre. The form of the crystal is a rhombic dodecahedron. Before the blowpipe it decrepitates slightly; with borax it yields a beautiful bluish-green bead in the reducing flame. It is acted upon by boiling nitric acid, and affords a bright blue solution. Very small quantities have as yet been obtained, but mineralogists may now be led to search for larger deposits, which, if obtained, will prove valuable to the owners of the mines. Vanadium forms a beautiful dark-blue colour on silk with tanno-gallic acid, which is stated to be very permanent; but no sufficient supply of this metal has yet been obtained for its commercial use.

REVIEWS.

The Land and Freshwater Mollusks indigenous to, or naturalized in, the British Isles. By Lovell Reeve, F.L.S. London: Reeve and Co. 1863.

One thing must be admitted of Mr. Reeve's books: they are always got out with great care and taste. The volume before us is another example, and is, typographically, and in size, paper, and illustrations, the *beau idéal* of what such a book should be. It is of most handy and convenient size, clearly printed, and illustrated with very characteristically and very nicely executed woodcuts. The matter is also good—we need scarcely say that of Mr. Reeve's conchological labours—and very conveniently arranged. First, is an Alphabetical List of Species, then a Systematic List, followed by an Analytical Key, displaying at a glance the natural groups into families and genera, and the characteristic features of each species. A map of both hemispheres shows the boundaries of the Caucasian province, over which the British species range, and the position of this area in respect to other areas, and the general terrestrial system. Of the broad, general divisions of molluscan distribution, Mr. Reeve recognizes in the eastern hemisphere the following provinces:—the Caucasian, the West African, South African, Malagan, Australian; in the western hemisphere—the North American, Columbian, Brazilian, Bolivian, and Chilian provinces. After a brief description of the appearance, condition, and extent of the British fauna, we pass on to some 240 pages of descriptive matter, giving the accepted names of each species, its synonyms, and its characters and habitats.

So important as fossil shells are in the palæontological history of the earth's past states, a good work like the present, on British shells, cannot fail to be of service to the geologist. Other books, such as Hanley and Forbes's 'British Mollusca,' exist, but such an elaborate and costly work is much beyond the attainments of ordinary students; while Mr. Reeve's less pretentious and inexpensive book contains all essential information. It is by the practical study of British shells that those British geologists who are not travellers must obtain their knowledge for the comparison of fossil mollusks, and the comprehension of the probable conditions of their ancient existence. The concluding chapter of Mr. Reeve's book, "On the Distribution and Origin of Species," will be read, however, by the practical geologist and naturalist with much interest. We all remember the late Edward Forbes's theories of Centres of Creation, and how fully the idea of species taking their origin each from a single pair, the progeny of which spread around and around the birthplace of its progenitors into wider and wider geographical areas, was accordant with popular notions. Mr. Reeve takes a very opposite view, and pleads for a plurality of originating individuals on the following important grounds:—Firstly, that land species, with greater facilities of migration than freshwater, are less widely and evenly diffused; secondly, that land and freshwater species of opposite hemispheres are not always representative, but sometimes identical; and, thirdly, that the range of land and freshwater species over areas or zoological provinces indicated by uniformity of type, is not arrested by the intervention of seas.

The following extract will suffice to show the important bearing of this chapter on geological science:—"The doctrine of the migration of all the individuals of a species from a single parent (or pair) involves the conclusion, that species permanent, as I think, in their character, and immutable, diminish in number in their march from the specific centre of a pro-nce towards its confines. Out of the many hundreds of land-mollusks habiting the Caucasian province at its specific centre, only ninety have ached the British Isles; of which thirty-five stop short of Scotland, and neteen in Ireland. Their progress northwards, it may be argued, is rested, to a great extent, by a change of climate, and in all directions by es, by mountain-barriers, by rivers, and by other physical and unknown .uses. It will readily be conceded that land-species have greater facilities ' locomotion than freshwater species especially inhabiting stagnant ponds id ditches; and it should follow, according to the doctrine of migration, iat the further off freshwater species are from the specific centre of a pro- ince, the more diminished in number than land-species they would be. 'he very contrary is the fact; out of five hundred and sixty species of Ielix inhabiting the Caucasian province, a very large proportion of which re assembled at its specific centre, we have but twenty-four in Britain, of which only eleven range throughout. The disproportion in the number of Clausilia is larger still. This genus is especially populous at its specific centre. Between two and three hundred species inhabit Austria and Hungary, yet we have but four in Britain, of which only one ranges throughout. Let us now turn to the sluggish mud-dwelling Lymnæacea of the ponds and ditches of the province. There are not six species, it may be safely stated, in all Europe more than there are in Britain. They have no particular centre of creation. There is no evidence to show whether the alleged primogenitors of our British species were created in Siberia, Hungary, or Thibet. There is scarcely any variation, either in the form or number of the species in those remote localities."

The other topics are equally well discussed, and valuable facts brought to bear upon them; and altogether, although the arguments are very concisely stated, we have very valuable considerations very lucidly put. A complete bibliographical list and an excellent index complete this useful volume, which will doubtless, and deservedly, find a proper place in most naturalists' libraries.

Year Book of Facts, 1863. By John Timbs, F.S.A. London: Lockwood and Co. 1863.

Every year Mr. Timbs issues, and we receive, a 'Book of Facts.' These are not, however, Mr. Timbs's facts, but the property of numerous people. The book is, as is well known, a series of cuttings from various publications, but not the less a useful book that it is composed of the "pickings" of wise men's brains. If we cannot always depend on the judgment and knowledge of the compiler, as displayed in his selections, or if we should think him a little too much attached to certain publications, and a little oblivious of or antagonistic towards others, he at least is not altogether unamicable, for he shows his partiality by naming and praising his favourites, and with respect to the rest, merely uses their matter, and consigns to oblivion their names and their fames. In the present volume the materials are beyond the average value of Mr. Timbs's former year-books; and besides the section devoted specially to Geology, there are scattered articles in various other portions interesting to geologists, such as the "origin of petroleum," "machine for cutting coal worked by compressed air," "Ransome's artificial stone," coal "and iron of South Yorkshire," "artesian wells," "secular cooling of the earth," and "the relations between earthquakes and magnetic disturbances."

Evidence as to Man's Place in Nature. **By Prof. Huxley, F.R.S. 8vo. Williams and Norgate. 1863.**

This work, which to biological inquirers who take an interest in the supreme question of Anthropological science—the origin of man, and the probability of his derivation from an inferior form—will prove a source of the deepest possible study and examination, is now published. It has so many points of similarity with the volume of Sir Charles Lyell on a cognate subject, that we shall prefer to discuss in a future number the whole question of man's antiquity. In the meanwhile we select a few of the passages by which Prof. Huxley advocates those conclusions to which he has been led during the past few years.

The work is divided into three essays: 1, the Natural History of the Man-like Apes; 2, the Relation of Man to the Lower Amimals; 3, the Fossil Remains of Man. As the criticism of the first two essays does not fall within the sphere of the 'Geologist,' we shall confine our remarks to the third essay.

It was Prof. Huxley's object "to show, in the preceding essay, that the *Anthropini*, or man family, form a very well-defined group of the Primates, between which and the immediately following family, the *Catarhini*, there is in the existing world the same entire absence of any transitional form or connecting link, as between the *Catarhini* and *Platyrhini*."

He confines himself in his remarks to the consideration of the skulls from Engis and the Neanderthal, and endorses the conclusion of Sir Charles Lyell, that the former "belonged to a contemporary of the mammoth (*E. primigenius*) and of the woolly rhinoceros (*R. tichorhinus*), with the bones of which it was found associated;" and that the Neanderthal skull is of great, though uncertain antiquity. Whatever may be the geological age of the latter skull, he conceives it is quite safe (on the ordinary principles of palæontological reasoning), to assume that the former takes us to, at least, the "further side of the vague biological limit, which separates the present geological epoch from that which immediately preceded it. And there can be no doubt that the physical geography of Europe has changed wonderfully since the bones of men and mammoths, hyænas, and rhinoceroses were washed pell-mell into the cave of Engis."

The description of the discovery of the Engis bones by Dr. Schmerling, as well as Prof. Huxley's notes thereon, follow. With respect to the Neanderthal skeleton, Prof. Busk's translation of Schaaffhausen is quoted at length. In Prof. Huxley's original observations he describes two beautiful photographs which he had received from Dr. Fuhlrott, the first of which demonstrates the great extension of the thickened supraciliary ridges beyond the cerebral cavity, and exhibits the wide openings of the frontal sinuses upon the inferior surface of the frontal part of the skull, into which, according to Fuhlrott, a probe may be introduced to the depth of an inch; and the second "exhibits the edge and the interior of the posterior, or occipital part of the skull, and shows very clearly the two depressions for the lateral sinuses, sweeping inwards towards the middle line of the roof of the skull, to form the longitudinal sinus." Prof. Huxley concludes that the posterior lobe of the brain of the Neanderthal man was exceedingly flattened and depressed, and that the posterior cerebral lobes must have projected considerably beyond the cerebellum.

After dilating at length on the varied forms of the human cranium, on which Prof. Huxley offers some most valuable remarks, he arrives at the conclusion that no comparison of "crania is worth very much that is not founded upon the establishment of a relatively fixed base-line, to which the measurements in all cases must be referred," such base-line being drawn through the centres of the basioccipital, basisphenoid, and presphenoid bones respectively. Examples are given of this mode of comparison.

Professor Huxley, we think rightly, declines to decide whether the Engis and Neanderthal skulls were more or less prognathous than the lower existing races of man, and turning to the Engis skull, he says, "I can find no character in the remains of that cranium which, if it were a recent skull, would give any trustworthy clue as to the race to which it might appertain. Its contours and measurements agree very well with those of some Australian skulls which I have examined, and especially has it a tendency towards that occipital flattening, to the great extent of which, in some Australian skulls, I have alluded. But all Australian skulls do not present this flattening, and the supraciliary ridge of the Engis skull is quite unlike that of the typical Australian. On the other hand, its measurements agree equally well with those of some European skulls, and assuredly, there is no mark of degradation about any part of its structure. It is, in fact, a fair average human skull, which might have belonged to a philosopher, or might have contained the thoughtless brains of a savage."

"The case of the Neanderthal skull is very different. Under whatever aspect we view this cranium, whether we regard its vertical depression, the enormous thickness of its supraciliary ridge, its sloping occiput, or its long and straight squamosal suture, we meet with apelike characters, stamping it as the most pithecoid of human crania yet discovered. But Professor Schaaffhausen states that the cranium, in its present condition, holds 1033·24 cubic centimetres of water, or about 63 cubic inches, and as the entire skull could hardly have held less than an additional 12 cubic inches, its capacity may be estimated as about 75 cubic inches, which is the average capacity given by Morton for Polynesian and Hottentot skulls. So large a mass of brain as this would alone suggest that the pithecoid tendencies, indicated by this skull, did not extend deep into the organization, and this conclusion is borne out by the dimensions of the other bones of the skeleton, given by Professor Schaaffhausen, which show that the absolute height and relative proportions of the limbs were quite those of a European of middle stature. The bones are indeed shorter, but this, and the great development of the muscular ridges noted by Dr. Schaaffhausen are characters to be expected in savages. The Patagonians, exposed without shelter or protection to a climate possibly not very dissimilar from that of Europe at the time during which the Neanderthal man lived, are remarkable for the stoutness of their limb bones. In no sense, then, can the Neanderthal bones be regarded as the remains of a human being intermediate between man and the apes. At most, they demonstrate the existence of a man whose skull may be said to revert somewhat towards the pithecoid type, just as a Carrier, or a Pouter, or a Tumbler, may sometimes put on the plumage of its primitive stock, the *Columba livia*. And indeed, though truly the most pithecoid of known human skulls, the Neanderthal cranium is by no means so isolated as it appears to be at first, but forms in reality the extreme term of a series leading gradually from it to the highest and best developed of human crania. One the one hand, it is closely approached by the flattened Australian skulls of which I have spoken, from which other Australian forms lead us gradually up to skulls having very much the type of the Engis cranium; and on the other hand, it is even more closely affined to the skulls of certain ancient people who inhabited Denmark during the 'stone period,' and were probably either contemporaneous with or later than the makers of the 'refuse heaps' or 'Kjökkenmöddings' of that country. The correspondence between the longitudinal contour of the Neanderthal skull and that of some of those skulls from the *tumuli* at Borreby, very accurate drawings of which have been made by Mr. Busk, is very close. The occiput is quite as retreating, the supraciliary arches are nearly as prominent, and the skull is as low. Furthermore, the Borreby skull resembles the Neanderthal form more closely than any of the Australian skulls do, by the much more rapid retrocession of the forehead; on the other hand, the Borreby skulls are all somewhat broader, in proportion to their length, than the Neanderthal skull, while some attain that proportion of breadth to length (80: 100) which constitutes brachycephaly."

"In conclusion, I may say that the fossil remains of man hitherto discovered do not seem to me to take us appreciably nearer to that lower pithecoid form, by the modification of which he has probably become what he is. And considering what is now known of the most ancient races of men,—seeing that they fashioned flint axes, and flint knives, and bone skewers, of much the same pattern as those fabricated by the lowest savages at the present day, and that we have every reason to believe the habits and modes of living of such people to have remained the same from the time of the mammoth and the tichorhine rhinoceros till now,—I do not know that this result is other than might be expected."

"Where, then, must we look for primæval man? Was the oldest *Homo sapiens* pliocene or miocene, or yet more ancient? In still older strata, do the fossilized bones of an ape more anthropoid, or a man more pithecoid, than any yet known, await the researches of some unborn palæontologist?

"Time will show. But in the meanwhile, if any form of the doctrine of progressive development is correct, we must extend by long epochs the most liberal estimate that has yet been made of the antiquity of man."

Such are a few of the more interesting passages which we have selected from Professor Huxley's work. The subject has been discussed in the 'Geologist' frequently during the last two years,* and we have no doubt that the publication of Professor Huxley's work, although it appears late in the month of February, will not fail to arouse the attention of geologists and anthropologists.

* Vol. iv. (1861), p. 396; vol. v. (1862), pp. 187, 201, 205, 303, 313, 314, 424, etc.

VIEW IN GLEN ROY, SHOWING THE PARALLEL ROADS, TAKEN FROM GLEN FINTEC.

THE GEOLOGIST.

APRIL 1863.

THE PARALLEL ROADS OF GLEN ROY.

By the Editor.

On each side of a long, hollow, deep valley, bounded by dark and lofty mountains, at elevations respectively of 1266, 1188, and 980 feet, three strong lines are traced on the mountain-sides, parallel to each other and to the horizon, and at levels exactly corresponding on the

Fig. 1.—Map of the Glen Roy district. *a a'*, probable glacier-barrier; ✝✝, Meal Roy, battle of the Macintoshes and Macdonalds; *f*, Glen Fintec; *x*, Glen Gastric; *t*, Glen Turit. The white lines indicate the "Parallel Roads."

opposite slopes,—so extraordinary in their appearance as to impress the most unphilosophical and incurious spectator.

These singular and solitary phenomena, although long known and celebrated by the Highlanders of that wild region as the traditional works of their great ancestors, remained unnoticed by science and the world at large, until that indefatigable disturber of hidden mysteries, animals, and antiquities, the tourist Pennant, published in 1769 a short account of Glen Roy, in his 'Tour through England, Wales, and Scotland.'

A second description appeared in the 'Statistical Survey of Scotland,' in 1793.

The subject was next taken up by Macculloch, who published an admirable paper, illustrated with views, maps, and sections, in the Transactions of the Geological Society for 1817. "So rarely," he remarks, "does nature present us in her larger features with artificial forms or with the semblance of mathematical exactness, that no conviction of the contrary can divest the spectator of the feeling that he is contemplating a work of art,—a work, of which the gigantic dimensions and bold features appear to surpass the efforts of mortal powers. We cannot wonder therefore that the solitary and poetical Highlanders, educated under mountain storms, and hourly conversant with the sublime appearances of nature, should attribute to the ideal and gigantic beings of former days, a work which, scorning the mimic efforts of the present race, marches over the mountain and the valley, holding its undeviating course over the impassable crag and the destroying torrent." But however convinced the Highlander may be that these "parallel roads," as they are called, were the works of Fingal and the heroes of his age, philosophers hold different opinions respecting them, and different opinions indeed they are that they themselves do hold. One attributes them to water, another to ice, and another to a cataclysmal wave surging and resurging over the Scotch mountains from the Atlantic. The matter was a disputed one amongst philosophers when Macculloch wrote, six-and-forty years ago; and just as he reviewed what others had thought before him, and added far better information of his own, so Mr. Jameson (the newly appointed lecturer on Agriculture in the University of Aberdeen) has recently investigated these natural curiosities afresh, and added much and most valuable information of his own.

Macculloch's description of the Glen Roy district and the "parallel roads" is very intelligible, and his suggestion that the latter were water-formed by standing water, was undoubtedly right, although the science of geology was not then sufficiently advanced for him to work out the whole subject to its issue. What he saw however he faithfully described. He begins with the source of the river, "or rather at the commencement of the valley, since the rivers, which form the Roy, rise in mountain-torrents, forming a junction in the middle of the valley." A low hill of granite skirts the boundary between the source of the Spey and the valley of the Roy. At the foot of this hill, in slightly elevated boggy plains, is found Loch Spey, the water from which, by a declivity for some time scarcely perceptible, runs eastward through Badenoch to fall into the Moray Firth. The western end of the boggy plain stretches for a few hundred yards beyond the head of Loch Spey, and then descends by a sudden step into the upper valley of Glen Roy. This valley is of oval form, about four miles in length, and one or more in breadth, being bounded on opposite sides by very high mountains. From these descend two streams, which unite about the middle of the valley to form the Roy. From this junction the water flows with a moderate velocity for the space of two miles, when the Glen suddenly contracts and terminates in a rocky hill of low elevation. The water, forcing its way for some distance through a narrow pass between approaching rocks, enters a second glen—the lower Glen Roy. It is in this latter that the "roads" are chiefly seen; nor on entering the upper from the lower glen would it be suspected that any similar appearances existed in it. A line however may be observed on the glen-side extending from the junction, which forms the Roy along the face of a low hill towards the elevation in which Loch Spey lies. "A careful examination of this line by spirit-level shows it to consist of a level narrow terrace, which, if prolonged eastward, would cut the perpendicular above Loch Spey, and if continued westward, would meet the summit of the flat rock that forms the division between the

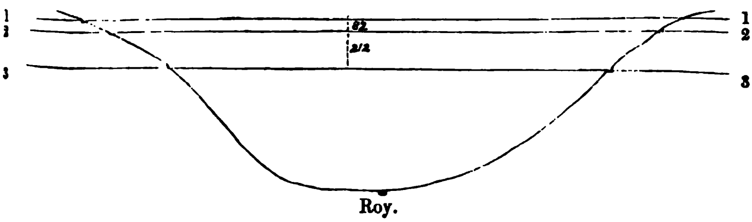


Fig. 2.—Section of Glen Roy, showing the contour and the levels of the three "parallel roads," 1, 2, 3.

higher and lower Glen Roy." This summit is on a level with the uppermost of the lines in the lower glen, the terrace being in fact a prolongation of that line. No other terrace or line is found in the upper valley. . . . Wherever the natural rock comes to light, these marks or lines are least discernible, being of much smaller dimensions, and having a much greater conformity with the natural slopes of the hill. Whatever loose matter occurs here consists of large fragments from the hills above; the natural rock projects in many parts of the lines so as to interrupt them, or they are wanting whenever a solid mass of rock occurs in their course. Independently of the principal lines, short indistinct traces of others are to be met with. Proceeding down the glen, a river enters on the left, equal in size to the Roy, and falling into it by a cascade over a rocky bed. Here a large series of terraces are found, forming a large *terre-plein* at top of this lower glen. These terraces are of different levels, as may be seen in the section and view accompanying this paper. The highest of these is on a level with the third principal "road." Successive stages of terraces descend to the bed of the river, the bottom of the glen being an alluvial flat. The general breadth of the "roads" is about sixty feet. Two glens, Glen Turit and Glen Fintec, open into Glen Roy, and on the sides of these "roads" are also seen. It is near the opening to Glen Turit, that the third or lowermost line is first seen. The following heights are given with others, by Macculloch, approximately by barometric measurements:—

Upper line ("parallel road") of Glen Roy above the Western Sea at Loch Eil	1262
Above the German Sea	1266
Lowest line of Glen Roy above the Western Sea	976
Upper line above land at Loch Oich	1180
Lowest line above land at Loich Oich	886
Upper line above the second in Glen Roy	82
Second line above the lowest in Glen Roy	212
Upper line of Glen Roy above the junction of the Roy and Spean	927
Lowest line of Glen Roy above the junction of the Roy and Spean	633
Upper line of Glen Roy above Loch Spey	63
Upper line of Glen Gloy above the Western Sea	1274
Difference above highest of Glen Roy	12
Bottom of Glen Roy at upper end above its bottom at the junction of the Roy and Spean, or its declivity	644
Height of Loch Spey above the German Sea	1203

On the left bank of the Spean, near the junction of the Roy, a *line* is visible, corresponding to the lowermost line of Glen Roy. It runs about three or four miles, but no corresponding line is found on the right bank on the Spean. It finally disappears opposite to Teindrish, where the valley is so wide that the opposite lines are four miles asunder. Glen Turit is at so great an elevation where it enters Glen Roy, as to exclude the two lower lines; but forms a connection between Glen Roy and Glen Gloy, rising between the two and discharging its waters on both sides. It is important, Macculloch continues, to notice that although the opposite sides of Glen Turit are very little dissimilar either in shape or composition, they do not equally exhibit equal traces of the "roads."

Glen Roy itself opens by a wide mouth, varying from five to seven miles, into the great valley which stretches from the northern to the western sea; the whole of this space is uneven and hilly. Applying the spirit-level to a great many points, Macculloch found them inferior to the lowest "road" of Glen Roy, with one or two exceptions. The opening of Glen Gloy is narrow. By a comparison of heights, Macculloch found that Loch Laggan to the east is depressed 369 feet below Loch Spey, and 432 feet below the uppermost "road" of Glen Roy. Supposing therefore that the water stood at the highest elevation in Glen Roy in the present state of the earth "it would run into the Spey not only by the channel of Loch Spey, but by that of Loch Laggan also." For these singular roads, Macculloch offered (1817) the ingenious solution that they had been formed by the waves, or littoral action of standing water. "The absolute water-level," he says, "which is found to exist between the corresponding *lines* both in Glen Roy and in those valleys which communicate with it, admits of a ready solution on the supposition that a lake once occupied this set of valleys; nor can it be explained on any other. As a free communication in one direction at least still exists among them, it would even now be easy to imagine the water replaced in the same situation; the difficulty of confining it will be a subject for future consideration. If, however, a lake be considered the cause, it is plain that the *lines* in question were once the shores of the lake; and it equally follows that it had existed at three different elevations, and that the relative depths of these three accumulations of water may be measured by the relative vertical distances of these three lines from the bottom of the valley. Thus the nature of the retaining obstacles becomes more complicated, and adds materially to the difficulties."

Having compared all the appearances of Glen Roy with those which are found in existing lakes, and considered the probable changes which the drainage of such lakes would effect on these containing-valleys, he proceeds to point out the difficulties with which even this hypothesis is encumbered.

"It has been seen," he says, "that considerable deficiencies may be observed in the courses of the 'lines,' as well in Glen Roy itself as in the neighbouring glens. Some of these anomalies indeed assist in proving the probability of the hypothesis; . . . the remainder, yet unaccounted for, may perhaps be explained hereafter. . . . One short 'line' only is found in the upper valley of Glen Roy; yet all the sides exhibit a general equality of slope, form, and texture; nor is any side more than another, subject to the action of a visible wasting cause. A great deficiency of the whole of the 'lines' occurs also towards the bottom of lower Glen Roy, and many partial ones in other places. Of these, some evidently arise from the rocky nature of the margin; and others may perhaps be the consequence of the coincidence between the slope of the hill and the slope of the supposed shore. But these causes will not account for them all; nor are there sufficient marks of the action of posterior waste to explain them. The anomalies of Glen Roy and Glen Spean in particular . . . seem at present to baffle all explanation, and in this unsatisfactory state must the argument remain. It were well if there were not further difficulties to encounter in adopting this hypothesis, but it is necessary to enumerate them. . . . As the level of the upper 'line' of Glen Roy is higher than those of many valleys which would at present afford passage to the supposed waters of Glen Roy into the sea, it follows that water could not now stand at that level unless these apertures were obstructed to at least a higher elevation. The determination of the position of these imaginary barriers is consequently the next point to be considered; as well as that of their number, since possibly two of these openings might be closed by a single obstruction." . . . "The uppermost one is of such a height that the water standing at that level would now flow out by Loch Spey and Loch Laggan, through the valley of the Spey, into the eastern, and by Loch Eil, Loch Sheil, and Loch Ness into the western sea. The two lower 'lines' lying below the barriers of Loch Spey and Loch Laggan, it would, under similar circumstances, find its way through the three latter openings only. The condition of the surrounding land must therefore have so far differed at that time from its present state, that various dams or barriers must have existed in the course of these openings. . . . The conditions of the present barriers existing at the source of Loch Spey and to the east of Loch Laggan, are such as to give no reason to imagine that they have once been higher. . . . By the removal of the supposed barriers to a point below Dalchully, one obstruction would . . answer . . . the purpose of confining the waters in this direction. If this were a mass of alluvial matter occupying the strath in which the junction of the Spey and the Truim takes place, it is not difficult to conceive that it was worn down by the action of the waters of the Spey, causing the drainage of the highest level in Glen Roy; or else after that drainage had taken place by the failure of some other barriers. The flow of the Spey and the Roy would then follow the directions of the intermediate ground, and the present courses of these rivers, as far as they were then free, would be established. If we now turn to the western side of Glen Roy, and examine the elevation and direction of the ground at its junction with the vale of the Lochy, we shall see that both Glen Roy and Glen Spean bear one common water-mark or 'line,' and unite in one common wide valley before they join the vale of the Lochy. The imaginary barrier must therefore be removed at least to that part of this valley where the 'lines' terminate, which is to a point beyond Teindrish. . . . But the form of this ground and the gradual dilation of the valley into that of the Lochy is such that no barrier could have existed here without occupying the whole of the present valley of the Lochy." Macculloch therefore proposes to remove this barrier to an indefinitely distant point towards the sea.

"If . . . Glen Gloy was dammed by a barrier of its own, independently of that which occupied . . . the common opening of Glen Roy and Glen Spean, we multiply our difficulties without necessity. A continuous lake must therefore be supposed to have existed among the present valleys of the Roy, the Spean, the Gloy, and Loch Lochy, independently of a portion of Strathspey." Macculloch then gives a map of the quantity of water he presumes under these circumstances must have occupied the surrounding country, but the positions he assigns to the barriers, and the condition he depicts for the country, are not entirely such as the glacier theory, hereafter to be noticed, will require. A considerable portion of Glen Lochy must therefore, he thinks, have formed a part of this common lake, and although he cannot determine its boundary in this direction, it must, according to his views, have extended at least to the north of the opening of Glen Gloy. But that valley opening into what would have been the middle of this lake, and being constantly diminished from the deposit of alluvial matter from the streams, while the permanence of the 'lines' upon the hills shows that they have undergone no violent changes, Macculloch does not incline to put any barrier there. If he attempts the great Caledonian valley, he gets entangled in a series of similar difficulties; in short, he does not find it possible to "fix upon a point which shall satisfy the requisite conditions." He then tries the lower end of Loch Lochy, which terminates in a wide alluvial plain; and urges that if any probable place can be selected here for the barrier, it is "at the narrowest part of the opening which lies at Fort William, between the skirts of the range below Ben Nevis and the opposite heights of Ard Gowar." He then refers necessarily to the other free opening which exists for the supposed lake through Loch Shiel and Loch Moidart. Another barrier must therefore be interposed in this direction; and thus there will be formed a large lake occupying Glen Roy to some point beyond the present course of the Spey and Glen Spean, with the whole of Loch Laggan and Glen Gloy, the great Caledonian valley, from a point of which he does not pretend to define the northern limit, to Fort William; Loch Arkeig and a part of the valley which includes it, and finally the western valley of Loch Eil to some undefinable point lying towards Loch Moidart and the western sea. The whole of this limit, he admits, is not demonstrable, but he considers the similarity, if not the actual community, of the "lines" of Glen Roy and Glen Gloy demonstrates that a portion or the whole of Loch Lochy was included in it.

Here, therefore, a serious difficulty arises. This is the total absence of all corresponding watermarks on the borders of Loch Lochy, as well as on the principal extent of the borders of Loch Laggan and the valley of the Spean. There is a set of common features through the whole tract,—the same rocks, the same slopes, the same causes of waste; yet the watermarks are strongly defined through a portion of this wide space, while they are totally wanting in others. The complete and sudden transition from the uppermost line of Glen Roy to the next succeeding one, and finally to the present bottom of the valley, shows a perfect draining of the whole. Macculloch thinks that the lake which occupied these valleys subsided at three different intervals; and further, that the more probable supposition is, that these three drainings took place at the same point; and he assumes it most convenient to take the present and lowest communication,—the exit of the water of the Spean and Roy as that point. "Here then," he says, "we must imagine a dam has existed, not gradually worn down by the slow corroding action of the river issuing from the lake, but by three successive failures occurring suddenly, or at least within short intervals of time. Had much time elapsed between these intervals, the several lines must have been more obscurely marked, or intermediate ones of smaller dimensions must have been visible. . . . Admitting, then, that the corroding action of the waters of the Spean and Roy, operating on an alluvium at the exit of the Lochy, had, by destroying a portion of the barrier, discharged that portion of the lake which stood above the second line of Glen Roy, a vertical distance of 82 feet, we have still left standing the other barriers, of the existence of which we cannot doubt, although their places cannot be precisely assigned. By what operation, then, were these lowered? If by any causes of a nature similar to those which we see in daily action on the surface of the earth, it must have been by the flowing of rivers upon them. Thus the flow of the Ness and the Spey towards the sea might have lowered the land in these directions to their present level, and thus the exit of Loch Shiel might have destroyed the barrier to the west; while the repeated failures of the supposed barrier at the mouth of the Lochy had, in the meantime, produced the complete drainage of Glen Roy and Glen Gloy, and, with the exception of Loch Laggan, that of the Spean."

Macculloch himself felt the difficulties he had to contend with, and these he puts forward so openly, so honestly, and so undisguisedly, that we feel that his facts at least are carefully-gathered truths, and that we can depend upon them. "I know not," he frankly says, "that the direct arguments which have been here stated are sufficient to prove that hypothesis, respecting the 'lines' of Glen Roy, which appears to be the best founded; or whether, combined with these indirect ones, which prove the impossibility of the two others, and the high improbability of the third, they may be held sufficient to establish its truth. I have, however, shown that although it still labours under unexplained difficulties, no physical impossibility is in any way opposed to its superior probability; we may therefore admit its claim for the present, at least so far as to justify us in examining the geological consequences likely to result from it."

Moreover, Macculloch distinctly saw that the causes he had assigned for the appearances in Glen Roy were attended by consequences materially affecting the notions which had been, with every appearance of reason, entertained relative to the ancient state and posterior changes of the great Caledonian valley. "It is conceived," he says, "by many persons that Scotland was once entirely or partially divided in this place by the sea, the highest elevation of the present land being 90 feet. By the constant descent and accumulation of alluvium from the mountains, it is supposed that the dams have been formed which now separate Loch Oich both from Loch

Ness and Loch Lochy, while these lakes have been disjoined from the sea by the large alluvial plains that now extend from them at each end, along the courses of the Lochy and the Ness. The operations required in constructing the Caledonian Canal have ascertained the reality and extent of these alluvia, while daily observation shows that they are in many places at least receiving an augmentation, that has a tendency at some far distant period to obliterate the lakes and convert the whole into one prolonged strath, of which the future summit will be Loch Oich or some point in its vicinity. If, indeed, we examine the changes which the lakes of Scotland are now undergoing, we shall find that they are receiving accumulations of alluvial matter at all the points where they are fed by the surrounding streams, while a comparatively small quantity of this alluvium is carried towards the sea. The result of this operation is to obliterate them and to convert them into alluvial valleys or straths. Instances of this revolution, more or less perfected, are numerous; while no case of the obliteration of a lake by drainage, similar to that of Glen Roy, can be pointed out."

But it is at this point of his argument that Macculloch encounters the most serious objection to his theory; not that that theory, as far as the ancient existence of a lake in the Glen Roy region is concerned, is erroneous; not that he was wrong in attributing to the action of the standing water of that lake, the erosion of the "parallel roads" of that and the neighbouring glens; but the difficulty existed in finding some natural way of constructing and in accounting by known physical causes for the total demolition of the barriers, considered as barriers of earth, whether of rock *in situ* or of accumulated alluvia. He feels this difficulty acutely, it is evident, for although he may be said to have completed his subject, he still goes on, through a dozen quarto pages, to comment on the difficulties of this position and to offer explanations. "It is not, however, inconceivable," he says, "that the causes which are now, by the accumulation of alluvium, obliterating the existing lakes, should, under some variation of ground, have heaped a barrier on the course of a valley, and generated at one period a lake which they were afterwards destined to destroy, or which, accumulating strength by confinement while the opposed barrier was undergoing a slow waste, should suddenly break its bounds and again desert the valley which it had been previously compelled to occupy"

This, however, is an argument which carries its own conviction of llacy, because the causes which were in operation to form a barrier 'alluvial matter could not be at the same time causes of destruc-on. If any causes were in action capable of forming a barrier ; fine earthy deposit to the height of 927 feet above the bottom of Hen Roy, the same causes could not possibly act, at the same time, n producing "a slow waste" in the opposing barrier. Besides, aking the opposite view, that the lake, by the accumulation of its water pent in by the barrier, acquired weight enough to burst it, what has become of the remains of such a gigantic mound? It could not have been washed away totally, and not have left a wreck behind. Macculloch's acute mind saw, too, the difficulty of removing the other earth-barriers, which must have remained after the breaking down of this one; "and other causes," he adds, "which we know not where to seek, must be found to explain the removal of alluvia from points where they appear at present to be, on the contrary, accumulating."

Such in the main are the natural features presented by Glen Roy; and such the excellent views put forward by Macculloch. That the "parallel roads" have been formed by water action, and are in point of fact ancient lake-shores, few are or have been much inclined to doubt. But the difficulty has been, as we have said, to find the barriers which held up the lake. Macculloch lived before these days of glacial theories, and he looked for a solid barrier of rock or earth; and it was naturally considered that if such a barrier had existed, some traces of its ruins should remain. Agassiz, some years since, suggested the possibility of the Glen having been blockaded by glaciers, but did nothing towards proving the case beyond giving out that suggestion.

Glacier-action, however, would eliminate all these incongruities from Macculloch's theory. A wall or barrier of ice would melt away and leave comparably to a bank of earth but very little trace indeed; this is the point Mr. Jamieson has taken up to investigate. Sir Charles Lyell has referred to the parallel roads of Glen Roy, and to Mr. Jamieson's previous labours in that region, in his recent work 'On the Geological Evidences of the Antiquity of Man,' but since the labours there referred to, Mr. Jamieson has communicated a valuable memoir on the subject to the Geological Society of London, of such importance that it must attract attention whenever it is published in the Society's Journal. In it he gives the proofs of ancient ice-action which he has met with in the district, and even assigns the places of the glacier-barriers; but, if we understand his meaning rightly from the portions of his paper read, he seemed to retain Macculloch's idea of a *deep* lake behind this ice-barrier.

In this we differ in opinion; hence the reason of our taking up the subject in this article. In the discussion which followed the reading of Professor Jamieson's paper, a great many valuable comments were made. Mr. Gwynn Jeffreys confirmed Mr. Jamieson's opinion of the relationship in time of the "parallel roads" to the great submergence in the Drift period,—namely, that the "parallel roads" were of more recent date,—and stated that in the "forty-feet beach," out of forty species of shells, three quarters of the number were Boreal forms, and one quarter Arctic, and that this beach was more recent than the Clyde beds, the shells in which were all of Arctic form. Mr. Mallet seized, with his characteristic astuteness, upon the difficulty of a deep lake being retained by a barrier of ice. He made some very excellent remarks upon the formation of the roads by lake-waves, and on the differences of lake-beaches and sea-beaches in respect to the curves and heights of the slopes formed by the shallow waves of the one, and deep waves of the other; but he appeared to us to go all wrong in his objection to the existence of an ice-barrier, by contesting that the ice being of less specific gravity than the water, the water of the lake would float and overturn the barrier,—an utter misconception, we conceive, of the case, which would have been better put by making reference to the absolute weight of the ice-barrier; for it is evident that the *lifting*-power of the lake water would be in proportion to its *depth*, and that for an object to be floated from *one side* the efficient raising power of the water must be got by doubling the height necessary to float the whole mass from both sides. Now, as the specific gravity of ice is to water as ·920 to 1·000, it is evident that the height of the water must be at least $\frac{8}{10}$ths higher than the barrier to be floated, and which kept it back. How then was the water retained on the one side, at such an elevation above that of the lip of the barrier itself?

If we conceive the whole region filled with glacier-ice, and that at a period when the climatal conditions had changed from the intense cold of the glacial era to a much milder temperature,—as is shown to have been the case, if the "roads" are subsequent to that epoch. by the proofs of amelioration of temperature at the period of the "forty-feet beach," shown in the increase of Boreal and the diminution of Arctic shells,—it is evident we must have had the formation of the roads taking place at a period of *thaw*, and therefore there might have been a comparatively shallow lake, caused by the water of the melted ice sustained in the hollowed surface of the glen-glaciers. The gradual melting of such glaciers would cause a weakening of the retaining barriers of the glacier-lake, and sudden débacles might occur; or the streams which now run through the glens may have been originally streams issuing at the feet of the glaciers, and cutting out the valleys beneath them; such streams do undermine glaciers, and when the collapse of the ice into the cavities or its launch forward took place, the lake on the summit might be discharged, or it might be merely and placidly slipped down to a lower level without any or with only a trifling discharge of its waters.

It might be, moreover, that the melting of the ice of the remains of glaciers at a higher level than the surface of this lake, caused a continual flow of the water of the lake, and gave it a cutting-power in addition to its wave-action.

At any rate, it seems more possible, as well as more probable, that the lake was a glacier-supported accumulation of water, than that a great barrier of ice should be erected in front of a body of water to shut it back. On the other hand, if the glacier were formed across an open plain, where was the water to form the lake to come from? The supposition, therefore, that the lake was formed by the melting of the glacier, and was held up on its hollow summit, appears to avoid some difficulties to which even the glacier theory of the origin of these singular roads is open.

ON A NEW FISH-JAW FROM THE GAULT NEAR FOLKESTONE.

By C. Carter Blake, Esq.,

Honorary Secretary to the Anthropological Society of London, and Lecturer on Zoology, London Institution.

My friend Mr. Mackie has handed me an interesting little fragment of jaw, derived from the Gault at Folkestone. The length of the broken fragment of jaw measures $1\frac{1}{8}$ inch; its absolute breadth $\frac{3}{8}$ of an inch. It contains three teeth, of which the largest is conical, incurved, exhibiting around its thickened base a series of sculptured linear depressions, parallel with the axis of the tooth, the interior of which has been converted into phosphate of lime; the second and the third also exhibiting similar characters, the third especially being acuminate, and exhibiting the natural apex of the tooth in an uninjured state. The conformation of such a tooth led my friend

Mr. Davies to compare it with the homologous structure in the teeth of the *Pachyrhizodus basalis* of Agassiz, which is described by Sir Philip Egerton, F.R.S., in Mr. F. Dixon's 'Geology of Sussex.' The specimen figured in that work was obtained from the Lower Chalk at Steyning. The characters, which are given, are—" apex very brittle, slightly curved inwardly, and solid; the base is hollow, and extends into the substance of the jaw." It is further stated that in Sir Philip Egerton's cabinet there is a specimen of this fish, exhibiting an unusually thick and strong humerus, as well as large and circular scales, covered with asperities so minute as to be indistinguishable without the aid of a glass.

There are many points of distinction, however, between the *Pachyrhizodus basalis* of Agassiz, and Mr. Mackie's specimen. Apart from the absolute size of Mr. Dixon's specimen, which is at least double that of the one before me, I am wholly unable to detect in the former any trace of that curious sculptured channelling which is so prominent in the latter specimen. This comparison failing, Mr. Davies showed me some most interesting specimens, also from the Folkestone gault, which exhibited equally perfect evidences of this sculpturing. I would therefore suggest that some temporary or provisional name should be given to this form, which differs from the *Pachyrhizodus basalis* of Agassiz, both in its stratigraphical habitat and its odontological conformation.

The genus Pachyrhizodus, of which comparatively so little is known, has been included in the family Sphyrœnoida, of the great division of Acanthopterygian (Cycloid) fishes, in close proximity to such singular aberrant forms as Saurodon and Saurocephalus. We hope that the day is not far distant when some practical ichthyologist may be induced to examine the whole series of sauroid fishes, with a view to their ultimate division into precisely determined families.

PACHYRHIZODUS GLYPHODUS, *Blake and Mackie.*

Spec. Char.—Teeth with longitudinal rows of deep sculpturing, parallel with the dental axis.

CORRESPONDENCE.

Glytolepis, Dura Den (Keuper Breccia).

DEAR SIR,—In claiming precedence for Mr. Robert Walker as the first to make public the fact that *Holoptychius Flemingi* belonged to the genus Glyptolepis, I ought to explain that this only applies to making it known in this country. Professor Pander, in his monograph on the Saurodipterini, stated his belief that the scales supposed to belong to *Platygnathus Jamesoni* and *H. Flemingi* of Agassiz, were in reality the scales of *Glyptolepis leptopterus*. The Professor's only mistake in this being that those scales belonged, not to *G. leptopterus*, but to a distinct species of Glyptolepis, which may be called *G. Flemingi*.

It may also be of interest to some of your readers to be informed that

I lately observed the "bone breccia" or "osseous conglomerate" of the Upper Keuper Sandstone, which I described some years since in a paper read before the Geological Society of London.

It is exposed in a railway cutting at the village of Ripple, between Upton-on-Severn and Tewkesbury, and contains the remains of spines of *Lophodus (Acrodus) minimus* in great abundance. I also recognized portions of *Ceratodus cloasinus*, of Quenstedt, with scutes and other fragments of the bones of Labyrinthodon. It is the richest Keuper-bed I know of in England, and well worthy the attention of all collectors of fossils. Henry Brooks, of Ledbury, would be a good guide to the place, and knows the bed which is so fossiliferous. I am, Sir, yours obediently, W. S. SYMONDS.

Pendock Rectory, near Tewkesbury, Feb. 26, 1863.

Holoptychius v. *Glyptolepis.*

SIR,—Mr. Powrie, in his communication in the last number of the 'Geologist,' says:—"The only species of Holoptychius on which I have never yet been able to detect scales showing the crescent of points is *H. Andersoni.*" It may interest Mr. Powrie and others also, concerned in the question of Holoptychius *v.* Glyptolepis, to learn that the typical specimen of *H. Andersoni* described by Agassiz, and figured in his 'Vieux Grès Rouge,' pl. 22, f. 3, now in the British Museum collection, has the sculpturing of points, which Mr. Powrie has failed to detect in other examples of this species.

In confirmation of Mr. Powrie's statement that he has detected them on scales of all the other species which he has examined, I can state that they are present, and well developed, on the posterior scales of the fine typical example of *H. nobilissimus* from Clashbennie, and also on scales of most of the specimens in the national collection, referred to this genus, from Dura Den, Nairn, etc.; and they are discernible on one or two of the scales of the fragment of Platygnathus in the same collection.

So far as my own observation goes, the "crescent of points" is entirely absent on the scales of the anterior portion of the body, but becomes more and more developed as the scales recede backwardly—dorsal, lateral, and ventral—towards the posterior portion. But this particular sculpturing is by no means a new discovery; it was observed by the earlier describers of the genus; and among others Hugh Miller, in his 'Old Red Sandstone,' describes them as "an inner border of detached tubercles." And M'Coy, in his description of *H. Andersoni*, says that in all cases, the anterior part" (of the scale) "is occupied by a patch of rather coarse radiatingly disposed granules, from whence the ridges arise that go to the free edge." He intimates, also, that they are present in his *H. Sedgwickii.*

Without offering any opinion as to the distinctive generic value of this sculpturing, there is one noticeable character, which is mentioned by Mr. Mitchell,—the much less degree of imbrication of the scales of Holoptychius compared with those of Glyptolepis; the scales of the former consequently exhibit a greater exposed surface, and are not so numerous as in the latter genus. And whilst the scales of Glyptolepis are so very variable in form and sculpturing, according to their position on the body, "whence," says Professor Huxley, "arises such an amount of unlikeness, that different species might readily be founded on scales from different regions," the scales of Holoptychius, on the contrary,—with the exception of the presence or absence of the lines of points, and minor differences of sculpturing and size.—bear, in the general style of the bold wavy ridges of their exposed overlying portions, a character which there is no mistaking, no matter what their position. Yours truly,

W. Davies.

March 12, 1863.

The Rev. W. Allen's Letter on Portland Fissures.

Sir,—Will you allow me to say a few words on the subject of Mr. Allen's letter in your last number? If his suggestion be correct, how is it that animals of distinct *genera*, if not *species*, from any known to have inhabited Britain in historic times are found in the Middle and Upper Oolite? And, again, if he be right concerning the "Upper Oolite" of Portland, why may not the same have taken place with other geological formations *after* the Oolitic series? And this we know cannot well be, as those succeeding it must be far older than 6–7000 years. Is it not more likely that during the Pliocene period (when man is supposed to have existed), the "Upper Oolite" of Portland was submerged; and, as the remains of an extensive estuary (in Dorset and Hampshire) exist close at hand, may not the human remains referred to by Mr. Allen have been washed down to the sea and so deposited in the submerged strata, than that a fresh sedimentary deposit has taken place, and the whole formation have been again upraised, and rent almost throughout, perhaps by volcanic action? Hoping you will excuse these perhaps somewhat crude remarks,

I remain, yours truly,

Charles Jicks, Jun.

Woodlands, Thorpe, near Norwich, March 23.

Norway Horses.

Sir,—At p. 26 of the 'Geologist' is an inquiry about the teeth of Norway horses. Last autumn, in a Norwegian tour, a friend, Charles Montagu Doughty, Esq., picked up by the sea, and near the North Cape, the tooth of a horse—which molar I have forgotten. It had not the aspect of a fossil, nor was it very recent, but, as Mr. Doughty suspected before I saw it, was certainly *Equus fossilis*. Although I have often found on our own coasts teeth of *Equus caballus* in exactly the same state of preservation, this cannot be regarded as more than suggestive evidence of the existence of the fossil form, since horses are not now kept so far north.

I am, Sir, faithfully yours,

Harry Seeley.

Cambridge, March 9, 1863.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Geological Society.—*February* 18*th*, 1863.—"On the Middle and Upper Lias of the Dorsetshire Coast." By E. C. H. Day, Esq.

The subdivisions of the Lias instituted by Sir Henry de la Beche and

Dr. Buckland from stratigraphical considerations, and the subsequent modifications and further subdivision established by recent careful comparisons of the fossils having been briefly noticed, the author proceeded to define the two portions of the Lias which were treated of in this paper. The Middle Lias was stated to comprise all the beds between the zone of *Ammonites communis* above, and that of *A. raricostatus* below; and the Upper Lias to include the beds commencing with the zone of *A. communis*, and ending with that of *A. Jurensis;* or, all those resting on the zone of *A. spinatus*, and superposed by that of *A. Murchisoniæ*,—the beds formerly termed 'the Sands of the Inferior Oolite' being referred to the Upper Lias. The sections exposed at Black Venn, Westhay Cliff, Golden Cap, and Down Cliffs were described in succession, the fossils found in each bed being given, as well as the vertical range of the Ammonites.

The occurrence of a new genus of the Belemnitidæ in the Belemnite-beds of the Middle Lias was noticed, and a description of its general features given, with a list of the associated fossils.

Mr. Day then exhibited, in the form of a generalized section, the different Ammonite-zones into which the Middle and Upper Lias of the Dorsetshire coast could be divided, and gave lists of the fossils peculiar to each.

GEOLOGICAL SOCIETY.—*March* 4.—"On the Permian Rocks of North-Eastern Bohemia." By Sir Roderick I. Murchison, K.C.B., F.R.S.

The author, accompanied by Dr. Anton Fritsch, of Prague, made a transverse section of the rocks exposed by railroad-cuttings between Josefstadt on the S.S.E. and Semil on the N.N.W. These rocks, simply termed Roth-todt-liegende by the Austrian and Saxon geologists, are however of very varied mineral characters and of very considerable dimensions. They consist, in ascending order, of, 1st, coarse conglomerate and sandstone, followed by thin courses of schist, with fishes (Palæonisci, etc.), and interstratified igneous rocks (basaltic clinkstone, porphyry, etc.); 2nd, alternations of coarse grits and sandstone, with large Araucarites and other plants; and 3rd, of bituminous schists, in parts containing coal, with some layers of limestone, copper-slate, etc., and many fossil fishes in bituminous flagstone passing up into red-and-green-spotted sandstones and marls.

This series of rocks, though subject to local undulations, assumes at Liebstadtl a steady dip to the S.E., or away from the Riesengebirge; this is well seen on the railway between Liebstadtl on the S.E. and Semil on the N.W., which section was described by the author in detail. The igneous rocks, chiefly amygdaloids and porphyries (Melaphyr), occur at various horizons in the series, and are supposed to have been, for the most part, of contemporaneous formation with the regular aqueous sediments.

Alluding to the animal remains, as enumerated by Geinitz, the author stated that he was disposed to view the group as having chiefly an estuarine character, the various sauroid fishes and the coarse conglomerates leading to that inference; at the same time he admits that portions of it were probably freshwater and terrestrial accumulations. After pointing out the chief localities of the large fossil stems of the Araucarites and other plants, allusion was made to the opinion of Göppert and Geinitz, that the fauna of this group is, as a whole, distinct from that of the carboniferous age. He shows that the thickness of the whole of these rocks in Northern Bohemia is very considerable. At Erlbach, in the adjacent country of Saxony, the inferior half only of these deposits, or the lower Rothliegende, has actually been sunk through by a shaft, in search of coal, to the depth of 2300 feet, as brought to his notice by Professor Keilhau.

In referring to the general relations of these rocks, he suggests that, as they vary very considerably in different regions, they are best defined by the word Permian, which, according to its original definition by himself and his associates in Russia, simply means that such rocks lie between the upper coal, on which they rest unconformably, and the lowest portion of the Trias, by which they are covered.

It was observed that, in proceeding from north to south (in eastern Germany), the Zechstein thins out; and seeing the vast dimensions which the group assumes where true Zechstein is no longer traceable, the author suggests that some of the higher members of the Bohemian Rothliegende may represent that limestone *in time*. The term Dyas, recently applied to the whole Permian group by Geinitz, is objected to, since it is based on the theory that the lower portion of the Permian is exclusively of fresh-water origin, as contrasted with the superjacent marine Zechstein, and also because the geographical term Permian, involving no theory, had previously been widely adopted, and even used by Geinitz himself.

Sir Roderick having expressed his great obligations to Dr. Geinitz, to whose excellent work ('Dyas') he made many references, and to the name of which only he objected, concluded by presenting to the Society a very large collection of rock specimens of the Lower Permian of Saxony.

March 18.—1. "On the Correlation of the several Subdivisions of the Inferior Oolite of the Middle and South of England." By Harvey B. Holl, M.D., F.G.S.

The order of succession of the subdivisions of the Inferior Oolite observed in passing from the southern side of the Mendips to the typical section of that formation at Leckhampton, with the lithological characters of the strata, were described in this paper. The classification of the members of the Inferior Oolite employed by Mr. Hull in the Memoirs of the Geological Survey, was adopted by the author; and it was shown that in proceeding from Bath northwards, the two upper subdivisions may be seen to rise, the building-freestone at the same time becoming thicker, while at Aveling the Oolite marl is first seen interposed between the lower ragstone and the lower freestone, and at Nailsworth the former is separated from the Oolite marl by the upper freestone, all these beds becoming thicker towards Cheltenham, and thinner in the opposite direction, towards Bath. Dr. Holl concluded with some remarks on the strata exhibited in the Rolling Bank Quarry, and on the geographical distribution in England of the members of the Inferior Oolite.

2. "On the occurrence of large quantities of Drifted Wood in the Oxford Clay, near Peterborough." By Henry Porter, M.D., F.G.S.

The Oxford Clay in the neighbourhood of Peterborough having been exposed in clay-pits, the author was enabled to carry on some investigations regarding the fossils which there occur in it; he found the formation to be extremely rich in organic remains, and, besides containing many species of Ammonites and other Mollusca, which he enumerated, to include large quantities of drifted wood, the fragments bearing on their surface the impressions of Ammonites.

3. "On a new Macrurous Crustacean from the Lias of Lyme Regis." By Henry Woodward, Esq., F.Z.S.

A very perfect specimen of a Crustacean, obtained from the Lias of Lyme Regis by Mr. Harrison, of Charmouth, was described in this paper as the type of a new genus. The nearest living analogues were stated to belong to the fossorial group Thalassinidæ, from which it differs chiefly in its much less rudimentary abdomen, and the length of its chelæ. Amongst fossil forms, this Crustacean, which was named *Scapheus ancylochelis*, approached most closely to *Megacheirus longimanus*, from the Solenhofen limestone, species of which genus occur also in the Oxford Clay of Wiltshire and the Oolite and Lias of Germany.

The following specimens, presented to the Society's collection, were exhibited:—

A specimen of columnar brown coal from near the Basalt, Gross Almerode; presented by W. J. Hamilton, Esq., F.R.S., Sec.G.S.

A cast of a fragment of a tooth of Mastodon, from a gravel-pit at Swaffham; presented by C. B. Rose, Esq., F.G.S.

Geographical Society.—*February* 23rd.—"On the Discharge of Water from the Interior of Greenland, through Springs underneath the Ice." By Dr. H. Rink. The whole of Greenland may be calculated to be somewhat more than 300,000 square miles, and there is reason to suppose that a mountain range runs through it from north to south, dividing it into two portions. There being also reason to believe that this water-parting lies nearer to the east than west side, Dr. Rink assumes that 200,000 out of the 300,000 square miles discharge their waters into Davis' Straits and Baffin's Bay. Every glacier is a mountain river; the upper part, turned into ice, still continues to move, but this change cannot extend so far as to comprise all the water contained in the original river. Some part of it must continue to flow, in a liquid form, either on the top of the glacier or through channels underneath it. Wherever the inland ice reaches the sea, having a perceptible motion out into it, there is always observed a motion in the water, in front of the outer edge of the solid ice, like that of *large springs* issuing from the bottom. The water looks as if it were boiling or agitated by a whirlpool, and myriads of sea-birds are continually seen to hover about these spots, incessantly diving and snatching after food in the brackish water. But the most remarkable thing is, that a lake, lying close up to the ice at some distance from the sea, presents phenomena similar to those in the sea in front of the ice. The water in it rises and falls periodically. When it rises the neighbouring springs from the bottom of the sea are seen to decrease; on the other hand, whenever it falls, the springs increase. Dr. Rink thinks that these phenomena might be carefully observed at a large ice-fiord during the winter, and that much valuable information would be the result.

Manchester Geological Society.—*January* 27*th*.—Two beautiful specimens of Aviculopecten were presented by Mr. Butterworth, of Moor Side. They were remarkable for retaining their natural convex form; specimens of this fossil being generally found quite flat. They are from the large nodules lying over the Upper Foot Coal at Doghill, near Oldham; the first mine above the Gannister.

A conversation then took place respecting the marine shells found in the black shales on the banks of the river Tame, at Dukinfield. Mr. Taylor said he had there found a *Goniatites Listeri* as large as the palm of his hand, and also a crinoidal stem. Mr. Binney had found Orthoceratites at the same place. These beds were generally looked upon as some of the lower series of coal-measures brought up by a fault; but no one has examined thoroughly the strata, and no fault having been proved, they may not unfairly be presumed to belong to the upper coal-field. Mr. G. Charlton said there was a sufficient breadth of strata between those known on each side to admit of the existence of a fault, but there were no indications of one that could throw up the lower measures there.

The papers read were—

1. "On the Cambrian Strata of the Isle of Man," by John Taylor, Esq., being the results of observations made on the Manx Cambrians during a series of visits, but more especially in the autumn of last year.

The sum of Manx geology may be stated in a few words. Along the southern coast, on each side of Castletown, and having that place as a centre, the Carboniferous limestone skirts the coast. It is separated into two divisions by a thick bed of dark and thinly-laminated shales, many of which are covered with Producti, etc. From underneath the lower beds of limestone, what Mr. Cumming calls the conglomerate of the Old Red Sandstone, crops out. This bed, however, the author takes to be a sort of passage from the Carboniferous downwards, rather than a representative of the Devonian formation. Certainly the Palæontological evidence is not in favour of its being decidedly Old Red, for the fossils most abundant are *Orthis Sharpii* and *Favosites polymorpha*; both these extinct forms being common to the Upper Silurian as well as the Devonian, and the latter is common both to them and the Carboniferous limestone. Striking off from the coast inland, we find that these two deposits terminate at about two miles; and in going up the Silverburn we see them cropping out, first the limestone and afterwards the red sandstone, both abutting against the highly-inclined strata of the Cambrian beds. The area which the limestone and red sandstone occupy is of a crescent form, having Poovlash on its right horn and Santon-burn on its left: the whole distance being much disturbed by outbursts of greenstone and trappean dykes.

From Port le Maury, along the north-western coast, we come upon the slate rocks, until we arrive at Peel, where a dun-coloured red sandstone rests upon them; the red sandstone rocks lying at a low angle. These beds skirt the coast as far as the Point of Ayr, but do not extend into the interior for a greater distance than four miles; the farthest inland point to which they extend being Kirkpatrick, where they are seen resting on the still highly-inclined Cambrian strata. With the exception of these Palæozoic deposits, and the more recently accumulated beds of Pleistocene age, the whole of the island is occupied by the Cambrian formation.

The author, referring to an editorial note attached to an article of his published in the 'Geologist' magazine of September last, in which Mr. Salter observes that we cannot tell whether these Manx clay-slates belong to the Cambrian formation or not, until they have been properly surveyed, says,—"At the most, this *dictum* is not attaching much value to the researches of Strickland, Forbes, or Cumming; and any one acquainted with but the slightest knowledge of the Welsh Cambrians, on arriving at the island would not fail to recognize in its highly-contorted beds the representative of the former. I have no doubt whatever but that these Manx beds belong to the true Cambrian system. So nearly are they allied in mineral structure to those of Wales, that practical slate-dealers are unable to tell the difference between the slates obtained from the recently opened quarries of the island, and those obtained at Conway. And not only in the mineralogical appearance of the beds is there a similarity, but also in the organic remains, few though they be, which the Manx beds have yielded. At the same time we have seen that the supposed representative of the Old Red Sandstone, as well as the overlying Carboniferous limestone, both abut and rest on the clay-slates themselves."

Owing to the contortions into which the clay-slates are thrown, it is exceedingly difficult to ascertain their thickness. It cannot be less, however, the author thinks, than several thousand feet. The general strike of the beds is E.N.E., the strata running in parallel mountain-ridges, of which the principal one is that passing through Slieanwhallin and North Barrule. The valleys between these principal ridges are mostly formed by the synclinal depressions of the strata—from one end to the other—the whole tract of the Cambrians being highly contorted, and broken up by faults. So powerfully have these contorting forces operated, that the author has seen, within the distance of twenty yards, no fewer than a dozen foldings. A good section, showing this phenomenon, may be seen along the vertical coast-line around Douglas Head, for a distance of three miles. Again, on the opposite side of Douglas Bay, the same feature presents itself; and a little further in the easterly direction, at Onchan, the rocks bounding its little bay are seen to form a huge anticlinal ridge, the strata passing over like the roof of an arch. All along this coast, as far as Ramsey, the same phenomenon may be studied. At times, however, great faults have intervened, arresting the agency which has so folded the strata, and turning it into another direction. Thus, on the eastern side of Greeba Mountain, the strata are exceedingly disturbed, great veins of white quartz intersecting the beds. On walking along the ridge of the mountain, and along the strike of the rocks, we perceive this folding suddenly to cease, and then the beds lie at a steep angle, but quite free from contortion. This peculiarity has been taken advantage of by Messrs. Ashe, and splendid slabs, fit for street pavements, etc., are now obtained from a quarry which they have recently opened there. Again, on a mountain opposite to Greeba, and to the east of it, at the Craig, we find the beds dipping at an angle of about 45°; but these are finely-laminated blue slates, quite sonorous and hard, and fit for building-purposes. The masses are also naturally cloven into rhombic forms. Further towards Peel, there is a slate quarry recently opened by the Isle of Man Slate Company, where the strata lie at a lower angle still, for the dip here is only about 30°; the rhombic cleavage still prevailing. But by far the finest section is that at Dalby, and seen from the coast. A fault occurs here, and, on the one hand the beds are in nearly a vertical position, whilst on the others are seen abutting against them.

The colour of these beds is not persistent. Near Douglas they have a sort of olive-grey; at Santon-burn they are of a claret colour; and in the slate-quarries alluded to they are perfectly blue. Like many of the Welsh slates, the surfaces of the laminæ are often coated with pyrites; and between the chinks of the cleavage the faces of the masses are nearly always so coated. The degree of hardness is also variable: in some places they are almost as soft as common coal-shales, whilst in others sufficiently hard and crystalline to take a considerable polish.

The organic remains are very scarce, and until a few years ago were thought to be quite absent. A friend of mine, Mr. Grindley, has, however, discovered a *fucoid;* and in the quarries behind Castle Mona Hotel the author has discovered both *fucoids* and the *tracks or castings of worms;* and in the slate-quarry of Messrs. Ashe, at Mount Craig, what he believes to be the section of an Orthoceratite. Near Laxey, ripple-marked slabs are exceedingly abundant.

At Dalby, and very near the spot where the above-mentioned fault occurs, a quarry has been recently opened in the vertical strata, where ripple-marks are, mostly plainly, to be seen. But by far the most important discovery Mr. Taylor considers is that made by him there last summer, that one of the vertical faces of the rock was distinctly marked by impressions, each about nine inches long, and following each other at a distance of about two feet. He says, "The impressions were about four inches on each side of a straight line, and were alternately on this side and on that. Three such impressions were distinctly visible, and doubtless on the same face of the slab more would have been met with, but masses of over-lying rock intercepted the view. These impressions were described by me in the above-mentioned article in the 'Geologist.' In opposition to Mr. Salter, who had not then seen the slabs, but only the drawing, and who was of the opinion that they were not organic, Mr. Mackie stated that he had no doubt of their organic origin, but was of the opinion that they belonged to a gigantic species of Lingula.* Whatever they are, I cannot tell, I have simply brought them before the notice of science, conscious that all traces of fossils which are found in the Cambrian beds will receive a careful examination. Whether they be *actual* footprints of some Chelonian, or merely imprints, I cannot say; but impressions of Chelonians have been found in the lowest Silurians of North America, and more recently, I believe, in Scotland. The outline of these Dalby impressions very much resembles the dotted outline of the Protichnites, figured in Owen's 'Palæontology.'"

Thin veins of Anthracite have been met with at Laxey; and near to Ballacraine, a lode of impure graphite, or plumbago, crosses the valley.

Granite comes up to the surface in two distinct places on the island, and in both instances emerges from beneath the slate rocks. The first place is at South Barool, and the second at Dhoon, about two miles beyond Laxey. In both instances it comes up as a huge bulging mass, or boss; in the former place occupying many square acres in extent. Around this boss there is a belt of pure white quartz, some score or two of yards wide, and containing large flakes of mica interspersed among it. At the junction of the clay-slate with the quartz the mica is more abundant, and for a short distance a sort of mica-schist passes into the slate-rocks. In the Cambrian strata of the island several layers of rock are fine-grained sandstone, as at the eastern horn of Douglas Bay, and again at the "Quarter Bridge," about two miles from Douglas. It is in the neighbourhoods of the granite that the metallic veins and lodes are richest, for at one place the Foxdale mines are most profitably worked, and near to the other we have the extensive works of the Laxey Mining Company.

The Cambrian strata in the island bear evidence of extensive denudation, for most of the valleys have been formed by the literal scooping out of rock; and it is not unfrequently the case that the hills on each side of such valleys may be seen to be the abutments of great arches of strata which have once bridged over.

There is just a glimpse of what this old land may have been composed of preserved in the Red Sandstone conglomerate. At Peel, where this conglomerate may be traced resting upon the inclined edges of slates, the imbedded pebbles are many of them of quartz, but *none of slate;* whilst these are accompanied with *limestone pebbles*, in which may be seen fossils of an undoubtedly Silurian character. Some of these limestone pebbles are several inches in length; consequently, they could not have been carried from a great distance, and the solid rocks whence they were derived must have been in the neighbourhood of the conglomerate itself, at the time when it existed as a rough shingle beach. It is therefore probable that the parent rocks of these fossiliferous pebbles once overlaid the present Cambrian strata.

2. "On the Edmond's Main Colliery Explosion." By Thomas Farrimond, Esq.

* This is scarcely correct. I noticed the peculiar fibrous structure which appears in the interstices between the cast and the matrix, and suggested, or meant to do no more than suggest, that this was possibly fibrous shell-structure, like that of the Lingula, or Pinna. I should scarcely like to say I believed in the former existence of a Lingula six or eight inches long. I exhibited the specimens kindly sent to me by Mr. Taylor at the meeting of the Geological Society, February, 1863. Unfortunately, I was not able to be present; but I could not learn from other Fellows who were there that any decided opinion was expressed about them.—ED. GEOL.

OYAL SOCIETY OF EDINBURGH.—At a conversazione held by the Royal ety of Edinburgh, on the 25th February last, specimens, maps, phoaphic views, and sketches, illustrative of the geology* and mineralogy Otago, New Zealand, were exhibited by Dr. Lauder Lindsay. They isted of—

A series of auriferous rocks and deposits, displaying—1. Their general mblance to those of all other auriferous countries yet known. 2. "Bed-k," or metamorphic slates probably of Silurian age; these slates proly form the geological basis of the greater part of Otago, especially of tral mountain-ranges, which vary in height from 5000 to 9000 feet. The general resemblance of these auriferous slates to the metamorphic es of Lower Silurian age of the Scottish Grampians; from this Dr. ndsay suggests the probable diffusion of gold in Silurian slates, and their derived "drifts" or alluvium in Scotland, "nuggets" having been eady found, according to his statement, in Leadhills, Tweeddale, Breadane, Sutherlandshire, etc. 4. "Drift," of Cainozoic age: named—per, consisting of clays, boulder-clays, and "chopped-slate" gravels; wer, characterized by lignite beds and associated strata. The goldning in Otago is mostly alluvial digging; in the Auckland [Coromandel] ld-field it is mainly quartz reefing.† The chief auriferous district is the sin drained by the great central Lakes Hawea, Wanaka, and Wakatip, d the Clutha River, with the feeders or tributaries. The principal works e in the Tuapeka and Dunstan gold-fields, and at the Lindis and Arrow ggings. Auriferous drifts occur also on tributaries, mostly head-waters, the Mataura [Nokomai gold-field], Tokomairiro [Woolshed], Waipori Waipori], Shag and Taeri [Mount Highlay diggings], Waikouaiti, and her rivers and streams in different parts of province, as well as on the ast [Moeraki beach], and in and around the capital, Dunedin [Saddlell]. Speaking generally, the greater part of Otago is auriferous, namely, er an area nearly equal to that of Scotland. 5. Minerals associated with old, or occurring in the auriferous drift—iserine, prevalent and abundant, nnabar, cassiterite, aquamarine [beryl], avanturine, etc. The predicon as to auriferous character of certain New Zealand rocks was made by ev. W. B. Clarke, of Sydney, Government geologist of New South Vales, in 1851. Since then, in chronological order, we have Aorere, Colngwood, Wangapeka, Buller River, and other diggings; operations begun 854–7: Coromandel diggings; operations begun 1852: the discovery of uapeka, by Thomas Gabriel Read, 4th June; proclaimed a gold-field, uly; and first gold-escort, 12th July, 1861: the Dunstan and Nokomai, roclaimed gold fields 23rd September, 1862: the New Zealand Goldelds Act, 1858–60–62: the Otago Gold-fields Regulations, 7th October, 861; amended 27th June, and 21st July, 1862. In respect to the auriferous productiveness of Otago during eighteen months, from the disovery of Tuapeka to the close of 1862, the total yield of gold was 50,000 oz., of the value of upwards of two millions sterling; probably in he following proportions:—from the Tuapeka gold-field, 360,000 oz.; Waitahuna, 90,000 oz.; Dunstan gold-field, 80,000 oz.; Waipori, 7,000 oz.; Woolshed, 6,000 oz.; Nokomai gold-field, Highlay, Lindis, Noeraki, etc., ,000: total, 550,000 oz. Towards the close of 1862, the mining popula-

* *Vide* chapter on "Geology of Otago," in a lecture on 'The Place and Power of Natural History in Colonization, with special reference to Otago.' Pamphlet, pp. 30. Dunedin, January, 1862.

† *Vide* papers on "Geology of the Otago Gold-fields," and on "Geology of the Auckland Gold-fields," read before Geological Section of British Association at Cambridge, October 5, 1862.

tion of Otago was 7,500, and a fortnightly escort brought to Dunedin upwards of 30,000 oz. of gold, giving to each digger an average of at least 1 oz. per week. Up to 31st March, 1862, the total export of gold from New Zealand was:—from Otago, 359,639 oz. = £1,393,600; Nelson, 46,591 oz. = £180,541; Auckland, 354 oz. = £1,372: total, 406,584 oz. = £1,575,513 value. With regard to gold-mining, Dr. Lindsay considers it destined to become one of the regular, permanent industrial resources of Otago; and he looks upon the supply of gold as at present unlimited, and considers all mechanico-chemical contrivances at present known as inadequate to the exhaustion of its auriferous deposits.

II. A series of lignites or brown coals. These were divided into, first, those of Cainozoic age, contained in the lower or older auriferous drift, and probably co-extensive therewith, and showing the abundance of the deposits, and their general distribution over the province. Other specimens displayed the transition stages from wood to coal, and illustrated the general resemblance, on the one hand, to the "Surturbrand" of Iceland, and the brown coal of Germany [Bonn, etc.]—Cainozoic lignites; and, on the other, to the "coals" of Mesozoic and Palæozoic ages. There were also some selected for comparison with the older and newer Cainozoic lignites of the Province of Auckland [Drury, Hunua, St. George's Bay, Auckland, etc.], and with the Palæozoic [Carboniferous] and Mesozoic [Cretaceous and Jurassic] coals of the province of Nelson. The second series of specimens were the so-called "coals" of Fairfield, Saddlehill, Tokomairiro, Clutha, etc.; sold at a market-price in Dunedin of £2 per ton. Appended to the specimens were the results of chemical analyses. Of the associated strata, the specimens exhibited were—quartz-conglomerate ["cement"] and sandstones, building-stones, clays, fire- and potter's clays, kaolins, ochres, laterite, shales and limestones, partly fossiliferous [Dicotyledonous leaves, etc.]; and of included minerals—iron-pyrites, alum, etc.

III. A series of fossiliferous limestones and associated strata, instituting a comparison with similar strata in other parts of New Zealand, at present supposed to be—1. Cainozoic, representatives of Eocene [Bognor beds, etc.], beds, etc.; Mesozoic, Cretaceous and Greensand, representatives of Maestricht and Faxö beds, etc.; Jurassic, containing *Plesiosaurus australis*, etc.; Triassic [equivalents of the Muschelkalk.]—3. Palæozoic, Permian and Carboniferous.

IV. Moa-bone deposits, organic remains mostly of dinornis, partly of palapteryx, etc.; age partly recent, partly Cainozoic, from the Waikouaiti bed, etc.

V. Kauri-gum deposits, indicative of former prevalence of Kauri forests over great part of Otago, mostly in Cainozoic strata [auriferous drift, etc.], Waitahuna, Tokomairiro, basin of the Clutha, etc.

VI. Volcanic [Trappean] rocks, mostly Cainozoic, with a general resemblance of those of Dunedin to those of Edinburgh. Basalts, columnar, spheroidal, granular, schistose [clinkstone and Lydian stone]. Contained minerals, zeolites, olivine, augite, etc. Tuffs, amygdaloidal, slaggy or scoriaceous; comparison of latter form with the scoria of the extinct craters of Auckland. Contents: Sulphur and sulphur muds, steatites, lithomarges, ochres, and umbers (used as pigments); siliceous and other pseudomorphs; schorl, nephaline, and other minerals; porphyries and amygdaloids [basalt and claystone, etc.], trachytes, etc.

VII. Illustrations of the parallelism between the Kjökkenmöddings of Denmark, and the refuse-heaps of former Maori pahs and villages. Shell-mounds, edible and existing species of *Cardium*, *Ostrea*, *Mytilus*, *Patella*, *Venus*, *Haliotis*, etc., Maori ovens and baking-stones, ashes and harred wood, Maori stone hatchets, or "celts" of clinkstone, Lydian stone, r nephrite, eggs and bones of moa mostly long bones, bones of man, ative dog, seal, fish, and various birds—mostly existing species penuin, albatross, rail, apteryx, etc.; bones partly charred, calcined, gnawed, roken, or marked by stone hatchets.

VIII. Insufficient data for accurate chronological grouping of rocks of)tago, arising, first, from a great portion of province remaining to be exlored, and the very limited portion of settled districts yet geologically xamined, and those only superficially; and secondly, from the difficulty of etermining European equivalents, and thereby age, in the present unatisfactory state of geological classification and nomenclature.

IX. Provisional chronology of chief rocks of Otago, as known to the lose of 1861. 1. Recent, superficial alluvium, brick-clays, certain moa-bone leposits. 2. Cainozoic, auriferous drift, upper and lower; lignite beds and ssociated strata, certain volcanic (Trappean) rocks, fossiliferous limestones, nd clays, septaria beds of Moeraki, moa-bone and kauri-gum deposits. I. Mesozoic, certain fossiliferous limestones. 4. Palæozoic, metamorphic lates, quartziferous and auriferous, possibly certain fossiliferous limestones, etc. The preponderance of strata were of the Palæozoic and Cainooic age, especially of the auriferous slates and their "drifts."

MANCHESTER PHILOSOPHICAL SOCIETY.—*March* 11.—Mr. Crookes, F.C.S., exhibited a specimen, weighing 450 grains, of the new metal, thallium, which he discovered by spectrum analysis. He stated that he had found this element in comparatively large quantities in the deposit from the flues of Mr. Spence's pyrites burners. E. W. Binney, F.R.S., the President, said that of late years considerable attention had been devoted to the examination of the beds of sand and gravel found in the valleys formed since the deposition of the till or boulder clay. Sir Charles Lyell, in his valuable work 'On the Geological Evidences of the Antiquity of Man,' has given us many facts connected with these valley gravels, especially relating to the terraces of the higher and lower level gravels found in the valley of the Somme, in which the flint implements have been met with. As these two deposits are seen in the neighbourhood of Manchester, he wished to direct attention to all excavations that were being made in them, in order that any remains or implements which might be met with should be preserved. Doubtless, many interesting specimens have perished, owing to the parties finding them being ignorant of their value. Many years since, a former member of this society, the late Mr. F. Looney, F.G.S., in speaking of the superficial gravel found in this neighbourhood, at p. 23,* says: "Imbedded in the gravel near the river-courses are occasionally found the stone celts of the ancients, from which it is presumed that the rivers, since the country was inhabited, have either sawn their beds deeper or much exceeded their present volume of water. Several large trees have been dug up from the sand and gravel; part of one is now lying near the residence of the Rev. J. Clowes, at Kersal Moor, which was dug from the Show Field on his estate, at upwards of 23 feet elevation above the present level of the river. A case more illustrative of this was beautifully shown in the winter of 1820, during the cutting away of part of the high ground at Castlefield, near the tunnel mouth, for 16 feet below the level of the grass a wooden box was found. It was square and formed of four upright posts, driven into a bed of clay; the sides and bottom were closed in with logs of wood: the logs were rudely hewn, had been riven, not sawn, from

* 'List of Organic Remains,' etc., and where found, to accompany Mr. Elias Hall's Introduction and Map, by Mr. Francis Looney, member of the Literary and Philosophical Society of Manchester, published in 1836.

5 to 6 inches square; some greenstone boulders lay at the botto the whole was covered with 16 feet of sand and gravel; 12 feet lower part had never been disturbed, the continuity of the layer unbroken.

SECTION.

Alluvium, 4 feet.

Layers of gravel, 12 feet, un

Box.

Layer of clay.

Gravel."

Mr. Looney was well known to be a most accurate and intelligent ol and his mention of stone celts having been found at levels above t sent river-courses appears to afford us fair hopes of their being fo the lower-level gravel if carefully looked for. But the most inte fact is the finding of the wooden fabric, by the author termed a box, although smaller in size, bears some resemblance to the *crannoge* sometimes in Ireland under the peat bogs. He (the President) ha been to examine the place where it was found, which is to the so and just outside of the old Roman station of Mancunium, in co with a party who saw the fabric when it was first exposed, and sto afterwards. The locality of course is now much changed, but the was able to point out to him the position where it was found, w now covered by No. 6 arch of the Altrincham railway, and said was about 6 feet square and 4 feet high. The four upright posts into the clay were about 5 inches thick and roughly riven, as we the slabs forming the sides and bottom. His informant did not not top to the fabric, or how the slabs had been fastened to the posts, remembers a layer of cobble stones, each about 6 inches in diamete ing a kind of pavement, being in the bottom of it. Upon these were some bones, which he examined, but did not recognize any c as human. All the wood appeared to be oak, but it was very rott fell to pieces soon after it was exposed to the air. None of it w served. Under the clay, the red rock (Trias) was found at a short d The geological position where the fabric was found is in the low gravel, about 29 feet above the water of the present river Irwel whatever purpose it was made, there can be little doubt as to its been the work of man, and as we are assured that the overlying sa gravel was quite undisturbed, there can be as little question of it antiquity, reaching as far back as the age of the lower-level gravels valley of the Somme, in France, where the flint implements hav found. Doubts have been raised as to these flints having been fa by human hands, but as to the origin of the wooden fabric, if, as st was covered by 12 feet of undisturbed sand and gravel, no such can rationally be raised.

The following paper, "On the Chemical Constitution of America Oil," by Mr. Schorlemmer, Assistant in the Laboratory of Owens C was communicated by Professor Roscoe :—

In a paper published in the October number of the Chemical Society's ournal, the author showed that the products of the distillation of cannel oal at a low temperature contain a series of homologous hydrocarbons of ie formula $C_n H_{n+2}$; and further that these are the hydrides of the lcohol radicles, as, upon treatment with chlorine, they yielded, by substi- ution of one atom of hydrogen by one of chlorine, the corresponding hlorides, from which other derivatives may be obtained.

In the portion of the oil boiling below 120° C., the author found the ollowing four hydrides:—

$C_{10} H_{12}$ hydride of amyl,	boiling-point	39° C.
$C_{12} H_{14}$ hydride of hexyl,	„	68° C.
$C_{14} H_{16}$ hydride of heptyl,	„	98° C.
$C_{16} H_{18}$ hydride of octyl,	„	119° C.

Of these, the hydride of heptyl or œnanthyl is the most interesting, as it was previously unknown, and he therefore undertook the investigation of its derivatives, concerning which likewise our knowledge is very limited and contradictory. Thus, for instance, many chemists state that the alcohol obtained by the distillation of castor oil with potash is heptylic alcohol, whilst others regard it as octylic alcohol, and it is only by the most recent experiments of Bouis* that we learn with certainty that this substance is octylic alcohol, inasmuch as he obtained the true heptylic alcohol by the action of nascent hydrogen on œnanthol. For the purpose of this investigation the author endeavoured to obtain the hydride of heptyl from the American petroleum, as the yield of this substance from the cannel oils is but small, and the labour of purification tedious and disagreeable.

The existence of this hydride in the petroleum was rendered probable by the fact of the discovery of hydride of hexyl by Pelouze and Cahours.†

The oils which he examined are those known by the name of turpentine substitute, and obtained as the first products in the rectification of the crude oil. Different samples of the commercial articles possess very different properties; the specific gravity lies between 0·70 and 0·75. One sample began to boil at 30° C., and the greatest portion distilled over below 100° C., whilst others between 80° and 150° C., and others between 100° and 200° C.

When the oils are subjected to fractional distillation, no product of constant boiling-point is obtained, the oils requiring for this purpose a preliminary purification with concentrated nitric acid.

The greatest portion of the oils remains unattacked, and the acid solution contains nitrobenzol (from which aniline was prepared), nitrotoluol and binitrotoluol, and small quantities of fatty acids produced from traces of olefines which are probably contained in the crude oils.

The author tried to separate these olefines by adding bromine to the crude oil until the colour of the latter no longer disappeared; a few drops, however, are sufficient for a large quantity of the oil, and when the whole s subjected to distillation, a very few drops of bromine compounds of a igh boiling-point remained behind, the quantity of which was too small or further examination.

The oil after this treatment was well washed, dried over potash, and recfied repeatedly over sodium. By fractional distillation, the following ur hydrides were obtained, and found to be identical with the hydrides om the cannel tar:—

* Compt. Rend., 55, 140. † Ib. 54, 1241.

C_{10} H_{12} hydride of amyl, boiling-point 34° C.
C_{12} H_{14} hydride of hexyl, „ 68° C.
C_{14} H_{16} hydride of heptyl, „ 98° C.
C_{16} H_{18} hydride of octyl, „ 119° C.

In addition to these he obtained a small quantity (about one gramme) of a liquid boiling between 20° and 30° C., and hence we may infer that also hydride of butyl is present in small quantities.

The author stated in the paper above alluded to that hydride of amyl boils at 39° C. The same compound from petroleum boils at 34° C. He finds, however, that the presence of traces of foreign substances alter the boiling-point of this body very considerably. Thus, for instance, he obtained from the crude oil about one ounce of a liquid which boiled from 15° to 20° C.; after treatment with nitric acid, the volume of the liquid remained almost unchanged, showing that only a very small quantity of substance had been removed; but, after drying with potash and rectifying over sodium, it was found that a mere trace of the liquid boiled below 30° C; nearly the whole distilled at 34° C., and consisted of hydride of amyl. Of the four hydrides which he isolated, he had only prepared the hydride of heptyl in quantity; four gallons of turpentine substitute boiling between 80° and 150° C., yielded three pounds of the pure compound.

In order to obtain from this other heptyl compounds, it was transformed into the chloride according to the excellent method described by Hugo Müller,* which consists in the addition of a small quantity of iodine to the substance which is to be treated with chlorine. The substitution occurs much more rapidly in this case than when chlorine alone is employed, and goes on in absence of the daylight, so that a rapid current of chlorine gas can be led into the liquid without any chlorine escaping with the hydrochloric acid vapours.

Hence it is seen that the constitution of American petroleum, at least that portion boiling below 120° C., is quite analogous to that of the oil from cannel tar.

Petroleum consists mainly of the hydrides of the alcohol radicles, it contains very small quantities of benzol and toluol, and probably traces of olefines, whilst in the cannel coal oil the hydrides are found in smaller quantities, and benzol and toluol in proportionally larger amounts. In the oil obtained by distillation of boghead coal, Greville Williams has discovered a series of hydrocarbons possessing the composition and physical characters of the hydrides C_n H_{n+2}, also benzol and its homologues and olefines.†

The rock oils obtained in other countries appear to posses a somewhat similar constitution.

Thus, for instance, Warren de la Rue and Hugo Müller‡ found in the Rangoon tar, benzol, toluol, xylol, and cumol and hydrocarbons of the formula C_n H_{n+2}. They were, however, unable to isolate from these a compound of definite composition and boiling-point. The rock oil from Sehnde, in Hanover, consists, according to the investigation of Busenius, Eisenstuck,§ and Uellsmann,|| of hydrocarbons of the same general formula, but they likewise failed to obtain definite products.

Pebal and Freund** found in the rock oil from Gallicia benzol and homologues, carbolic acid and homologues, and hydrocarbons which are not attacked by the strongest acids, and probably identical with those previously mentioned.

* Journ, Chem. Soc., 15, 41. † Phil. Trans. 1857. ‡ Jahresbericht, 9, 606.
§ Liebig's Annalen, 113-115. || Ib. 114-279. ** Ib. 115, 119.

ι the Microscopical Section, (16th February,) Mr. R. D. Darbishire ented specimens of mud and fossil shells (received through Dr. P. P. ɔenter) from the Post-pliocene or latest Tertiary deposits at Logan's n, Mile-end Quarries, near Montreal, Canada, described by Sir C. ll ('First Travels in North America,' vol. ii. p. 135), and in Papers Dr. J. W. Dawson in the 'Canadian Naturalist,' 1858 and in 1859. Darbishire, in a note to the Secretary, stated that one of the pecu-ties of the deposit is that it seems to have been formed in a quiet ɔw. Spiculæ of sponges are found in position, as if the sponge had rn and been quietly buried on the spot. Amongst other character- fossils are numerous Foraminifera, and a siliceous and close-tex-d sponge, referred to Tethea, of the species *Logani*, which is now d in water from the tide-line to 200 fathoms deep.

ɔTSWOLD CLUB.—From a reprinted paper on *Gryphæa incurva*, plates by Mr. John Jones, of Gloucester, which we have received, it ars that old and valuable club, the Cotswold, are devoting their re-ces to really good work. In Vol. III. of this periodical we printed a r on *Rhynchonella acuta* by Mr. Jones, and the steps which that or then took to work out the identity of many so-called but unreal ies he has repeated in respect to that more common and character- bivalve mollusk of the Lias, abundant and familiar, though it would ı in all its varieties yet not always a well-known shell,—the *Gry-s incurva* of British and *Gryphæa arquata* of foreign writers. The wing extracts from Mr. Jones's paper will convey the views he promul-s in respect to the various forms of Gryphæa which have received spe- names.

Gryphæa.—'A free, (except when very young,) unequal-valved, inequi-al bivalve, larger valve involutely curved, concave, smaller valve flat- beakless; hinge, a transversely striated pit, containing an internal nent, without teeth or crenatures.'

The Liassic species, recognized by most English writers, to which the going generic terms apply, are those to which we have now to address elves, and may be stated as follows:—*Gryphæa incurva*, Sowerby; *suilla*, Schlotheim; *G. obliquata*, Sowerby; *G. Maccullochii*, Sower- *G. depressa*, Phillips; *G. cymbium*, Lamarck; all of which, labelled bove, are to be found in most collections of importance throughout kingdom, and are more or less common (as we believe) in this district. Upon inquiring where, as tyros, we may find pictorial illustrations of differences between them, we learn that we must refer to the works l as follows:—For *G. cymbium*, to the 'Encyclopédie Méthodique;' 'Petrefacta Germaniæ' of Goldfuss; the 'Coquilles Fossiles des irons de Paris' of Deshayes; Sowerby's 'Mineral Conchology;' or lips's 'Geology of Yorkshire.' For *G. depressa*, to the last-named ι. For *G. incurva*, to two of the former works; to the 'Petrefacten' ieten; and Parkinson's 'Organic Remains.' For *G. suilla*, to Gold- 'Petrefacta Germaniæ.' For *G. obliquata* and *G. Maccullochii*, to erby's 'Mineral Conchology.'

It is scarcely necessary to observe, that all these works are of so expen-a character, as to place them beyond the reach of the great majority eological students; that they are all out of print, and not always at-ible by those who *can* afford to purchase them; hence, therefore, the ability of carrying out the design we have formed. It will be seen in ιequel, that we shall have occasion to refer to various other supposed ies, described by Continental authorities.

The first which claims our notice in stratigraphically ascending order is the *Gryphæa incurva* of Sowerby, or *arcuata* of foreign writers, the latter being the name under which it was described by Lamarck, the typical form of which has been figured by the following, amongst many other authors:—Bourget, 1742, Traité des Pétrifactions (Paris), pl. 15, f. 92; Walcot, 1779, Description of Petrefactions near Bath, p. 51, f. 34; Encyclopédie, 1789, p. 189; *G. arcuata*, Lamarck, 1801, Système des Animaux sans Vertèbres, p. 398; *G. arcuata*, Parkinson, 1811, Organic Remains, vol. iii. p. 209, pl. 59, f. 4; *G. incurva*, Sowerby, 1815, Mineral Conchology, vol. ii. p. 23, pl. 112, f. 1, 2; *G. arcuata*, Lamarck, 1819, Animaux sans Vertèbres, vol. vi. p. 198, no. 4; *G. incurva*, Defrance, 1829, Dictionnaire des Sciences Naturelles, xix. p. 536; *G. arcuata*, De Blainville, 1825, Manuel de Malacologie et de Conchyliologie, p. 59, f. 4; *G. incurva*, Zieten, 1830, Die Versteinerungen Würtemberges, p. 65, pl. 49, f. 1: *G. arcuata*, Deshayes, 1831, Descriptions des Coquilles Caractéristiques des Terrains, p. 98, pl. 12, f. 4, 6; *G. arcuata*, Goldfuss, 1835, Petrefacta Germaniæ, pl. 8, f. 1, 2; *G. arcuata*, Roemer, 1836, Die Versteinerungen des Nord-Deutschen Oolithengebirges (Hanover), p. 62; *G. arcuata*, Schmidt, 1846, Petrefacten-Buch, p. 61, pl. 18, f. 3; *Ostrea arcuata*, Deshayes, 1849, Traité Elémentaire de Conchyliologie, pl. 56, f. 8, 9; *Ostrea arcuata*, D'Orbigny, 1850, Prodrome de Paléontologie Stratigraphique, vol. i. p. 220. It is, in fact, the shell invariably figured as the best type of the subgenus to which it belongs, and cannot fail to be recognized from the rudest figure, or from the following description, which is here somewhat amplified from Sowerby.

"*Specific Character.*—'Elongated, very involuted, right side' presenting a more or less 'strongly marked, or an obscure lobe,' (when viewed with the smaller valve placed downwards, and the umbonal portion turned away from and at right angles to the front of the observer,) 'lesser valve oblong,' 'externally concave.'

"This description applies only to the ordinary adult form, than which none would appear at first sight to be more easily determinable; but the following list of what are considered by some authors of repute to be distinct species, and merely synonyms of one, by others, will at once give an idea of the notable modifications and changes of form of which this species is susceptible, the shells named in it representing every imaginable gradation between the outlines of the common oyster and those of the most perfectly developed *G. arcuata*. *G. Maccullochii* of Zieten, t. 49, f. 3; *G. læviuscula* of Zieten, t. 49, f. 4; *G. ovalis* of Zieten, t. 49, f. 1; *G. Maccullochii* of Sowerby, t. 547, f. 1, 2, 3; *G. gigantea* of Sowerby, t. 391; *G. obliquata*, Goldfuss, t. 85, f. 2; *G. obliquata* of Sowerby, t. 112, f. 3; *O. irregularis*, Goldfuss, t. 79, f. 5; *O. læviuscula*, Goldfuss, t. 79, f. 5; *O. ungula*, Münster, 'Handbuch,' (young,) t. 325; *O. semicircularis*, Roemer; *O. irregularis*, D'Orbigny, 1853, Prod. vi. p. 238; *O. intermedia*, Terquem; *G. depressa*, Phillips; *G. lobata*, Buvignier. Although oysters have been found in much older formations, as exemplified by the unique specimen of *Ostrea nobilis*, from the carboniferous limestone of Belgium, which may be seen in the British Museum, with others from the Triassic 'Saliferian' of St. Cassian, they amount in number of species, in the opinion of Mr. S. P. Woodward, to three only, and it is first in Jurassic strata that they make their appearance in any remarkable number or variety.

"Taking into consideration this fact, with that of the universally admitted variety of forms attributable to one species: to those who have interested themselves in the theory of transmutation, as originally propounded by Lamarck, subsequently by the author of the 'Vestiges,' and since, more ctically by Darwin, in his treatise 'On the Origin of Species,' the ela-ation of figures, and the minute details here presented, although ap-ently uselessly repeated, may yet assume an aspect of interest which y could not otherwise possess. *Ostrea interstriata* (*Plicatula* of Em-ich) of the White Lias, and the small oyster which covers the slabs Lower Lias at Wainload, Westbury, Penarth, etc., associated with *diola minima*, recognized by Buckman and other local writers as *Ostrea sica*, are the earliest known to us in this district. Distinctly gry-id forms occur considerably higher in the series, and are most abund- from the zone of *Ammonites Bucklandi*, to that in which it is supposed e replaced by *Gryphæa obliqua;* but any one who has carefully exa-ed these in considerable numbers, and can therefore fully appreciate infinite diversity of form which they assume, rendering the determina- of the differences between Oysters and Gryphites exceedingly per-ing, may possibly, in the sequel, feel disposed to adopt the suggestion Quenstedt, that *Ostrea liassica* may really be the ancestral precursor he species under consideration."

ix plates of illustrative specimens are given by Mr. Jones, and six rto pages of minute description and comparison.

he actual vertical range of this species extends, Mr. Jones believes, nearly he base of the Lias formation, and much lower than the beds in which it t becomes known to us by the name, hitherto applied to its commonest n. "Upon close inspection, almost every specimen of Gryphæa will show t it has been in its earliest stage attached, by the flattened or scarcely nded extremity of the beak, to a foreign body, and it is noticeable that symmetrical development of the adult appears to have mainly de-ded upon the period at which it became free, the comparative duration which, in various individuals, being indicated by the extent of area so nded or flattened. . . . Upon transferring to paper the outlines of t portion of the shell only which could have existed at the time of its ming its liberty, which is easily done by tracing, in well-cleaned ex-ples, those lines of growth of which the edges converge at the point re the profile curve of the external portion of the true apex commences, from which the lines of the ligamental fossa recede, it will be clearly n that it must once have so closely resembled the young of an oyster, as ender it difficult to distinguish the one from the other." Having arrived he conclusion that the young Gryphite must, for a period more or less ertain, resemble an oyster, Mr. Jones's figures specimens to show how g such resemblance might endure, and to what extent it could proceed; of these being attached by a base so large, the upper valve so rugose and vex, with ridges following, and corresponding with the inequalities of shell upon which it grew, exhibiting very obscure and irregular con-tric lines of growth, and an appearance so completely that of an oyster, different to that of a Gryphite, "that no one," Mr. Jones says, "who never seen similar specimens, in a series of still further advanced ges, could admit its relationship in any degree to the latter."

ould the young animal, by its own volition, free itself from connection h the body to which it had attached itself? This Mr. Jones thinks may answered affirmatively, from the fact, that in the majority of instances, t connection could have endured but for a short time. The primary nt of adhesion must in general have been so small in the young fry, applied to surfaces so even, that a very slight exertion of force of any d, either voluntary or involuntary, would have sufficed to detach it; but an be readily conceived that in the event of adhesion taking place to ven surfaces, the union between the two bodies must have become so complex as to render separation impossible, except by the application of very considerable force.

In the event of contact remaining unnaturally prolonged, as in the case of *Ostrea læviuscula* and *O. irregularis* of Münster, the foregoing observations would in all cases properly apply.

"There can be no doubt, that the great confusion of ideas which has existed with regard to what we consider to be one species, as evidenced by the hosts of synonyms for it, to which we have been compelled to refer, arose from that love of species-making which characterized most of our earlier palæontologists. No sooner did an abnormal form present itself, than it was seized upon and *named* as a new species, whilst the examination of the series would have shown its true connection with common types. In species of which the number varies so much individually, as in the oyster-tribe generally, this precaution is most essential, to enable us to arrive at safe conclusions in this respect: the most *symmetrical* forms having been set up as types, whilst, in point of fact, these are rather exceptional than otherwise.

"We can convince ourselves," Mr. Jones concludes, "in the instance of *G. incurva*, that this shell is capable of assuming every shape between that of a flat oyster and one of so different a development as to have suggested the propriety of conferring upon the individuals exhibiting it, a distinct *generic* name. It has been shown, how the entire character of the shell has been effected, by circumstances which enforced upon it a more or less permanent adhesion to the body to which it had primarily attached itself; that the lateral furrow, upon the presence or absence of which specific differences have been supposed to depend, is one of the most fallacious characters upon which they can be based. We can perceive that the differences between the assumed species *G. incurva, obliquata, Macculochii*, and *cymbium*, are less than those existing between the young, half-grown, or adult states of either. We know that other creatures, inhabiting the same sea-zones, pass upwards from the point at which they first appear, through a greater, or at least as great, a stratigraphical range as either of these. Do we not then rightly pause before we draw sharp lines of demarcation, whilst neither the facts presented to us in the formation under consideration, nor our knowledge of physiological facts, as exemplified in the existing life of our own epoch, afford us any valid pretext for so doing?"

To show in the clearest possible manner the nature of these differences, Mr. Jones has constructed a diagram, representing *Gryphæa incurva* of the best known-type and fullest dimensions. By uncovering the drawing from its younger portion upwards, may be made to appear in succession, first, its oyster condition; secondly, that of *Gryphæa suilla;* thirdly, that of *G. obliqua*, young; fourthly, that of *G. obliqua*, adult; fifthly, *G. incurva*, half-grown; sixthly, ditto two-thirds grown; seventhly, adult; eighthly, in its most aged form. A comparison of any of the forms we have referred to, made by placing almost any two shells of different sizes in juxtaposition, so that the curves of their beaks shall be as nearly as possible parallel, will exhibit the same difference of degree between them, in quite as satisfactory a manner.

The names by which the numerous varieties have been hitherto known, and under which they are figured, Mr. Jones suggests, may admit of use, as those of *varieties* only of *G. incurva*, as which they ought to be generally recognized. The results of Mr. Jones's investigations then may be thus stated, that not only is there no clear distinction between these so-called species when studied in a fairly selected series; that no particular form is special to any stratigraphical portion of the Lias; but that in the Cotswold district, wherever Gryphites numerously occur, all the forms most widely diverging from the ordinary type of *G. incurva* are found, presenting differences from it, so infinitely modified as to make arbitrary separation between them of specific value, quite as unintelligible as absurd. These observations may be applied with equal propriety to other species and genera of shells equally common in the Liassic strata."

The ANNUAL MEETING of this club took place on March 4th, on which occasion there was a large muster of the members and their friends from different parts of the county. Captain Guise, president, read the annual address, in which he gave a detailed account of all the different meetings which had taken place during the past year, and pointed out the various novelties which the members had noted in their excursions to Weston-super-Mare, Cardiff, Penarth, etc. After the address, the meetings for 1863 were fixed, and Mr. Buckman's report on the tumulus opened by the club at Nymphsfield last summer, was read; one very fine human skull and portions of other skulls obtained from this ancient burial-place, were exhibited. At the dinner fifty-eight members were present. Dr. Wright read a report on the collection of organic remains made by Miss Holland, of Dumbleton Hall. The Lias beds in the neighbourhood of Dumbleton consist of Lower Lias, Middle Lias, and Upper Lias. The report contained an enumeration of all the species found in each of these divisions of that great formation; these detailed lists will appear in the Transactions of the Society. Dumbleton Hill has long been a capital locality for the fossils of the marlstone and for the fish-bed of the Upper Lias. Dr. Wright likewise exhibited a vertebral and other bones of a large reptile, which had lately been discovered at Stowell Park. This saurian is new to England, although the same or an allied form has been found in a formation of the same age, the Great Oolite of Normandy. The bones belong to the genus *Teleosaurus*. The next communication was by the Rev, T. W. Norwood, on a tumulus which had been recently exposed at Foxcote, near Whittington, in this county. This locality had been visited on February 25th, when several human bones, horses' bones, and flint-flakes were found. In another part of this tumulus a vessel containing a number of Roman coins of Valens, Valentinian, Tetricus, Faustina, Constantine II., Claudius II., was said to have been discovered, together with a fragment of rude pottery and a piece of rusty iron. The author believed the grave to have been a Roman burial-place of about the fourth or fifth century. The next paper was an account of the natural history of the Severn, by Mr. John Jones, of Gloucester. In it lists were given of the fishes, shells, diatoms, and plants living in the estuary of the river.

Mr. Notcutt read an outline of the proceedings of the Cheltenham Working Naturalists' Association, formed in 1861, for the purpose especially of uniting the naturalists of the town in the effort to work out a complete flora and fauna of the district. The area which the Association has thus undertaken to work out, embraces a definite district laid out on the Ordnance map, and averaging a radius of about six miles from Cheltenham as a centre;—649 species are found within these limits. Of these 112 are new to the district, being unrecorded in the Flora published eighteen years since by Mr. Buckman; while 67 of the plants recorded in that work have not been seen by the members; of these, it is believed that 17 are either extinct in the places assigned for them, or are misnomers, while the other 50 will probably be yet rediscovered. The mosses have been studied by Mr. Beach, and his lists contain 146 species. In the animal kingdom, Dr. Bird has contributed a list of 24 species of mammals. Mr. Wheeler reports 159 species of birds, and eight species of reptiles are noted by the Rev. T. A. Marshall. The same gentleman has contributed lists of 567 species of Coleoptera and 172 species of Hymenoptera. Mr. Beach has detected 71 species of Mollusca, and Drs. Abercrombie and Wilson, 87 species of Diatomaceæ. Collections of several of the tribes investigated have been commenced to serve as a permanent record. It was also urged that it would be exceedingly desirable that the same work should be done for the whole county which is being done for this district.

NOTES AND QUERIES.

Highest Beds of the English Chalk.—For a long time the fossil from the Norwich chalk have been known to present slight, but peculia distinctions from those of other districts; and the Norwich chalk ha been often regarded as a higher stratum than any other in England. Th recent description by M. Binkhorst (see "Reviews," vol. vi. p. 240) of th fossils from strata at Maestricht, containing casts of univalve-shells, suc as occur in similar beds between Dover and St. Margaret's, showing thei proximity to the highest cretaceous beds, has directed my attentio afresh to a portion of one of the most interesting chalk sections in Eng land,—that in the vicinity of Dover. Since William Phillips's admirabl paper, read before the Geological Society in 1818, nothing has been pub lished on the geology of that part of the Kentish coast; but, during a lat visit, having obtained from the low cliffs at Kingsdown (left-side of view Plate VIII.) specimens of *Micraster cor-anguinum*, unlike those usuall found in the Dover and Maidstone Upper Chalk (see ordinary form, Fig. (Plate III.), but agreeing closely witht he gibbous variety so abundant in th Norwich chalk, I beg to solicit information from geologists of the cha racteristic features and fossils of the highest beds of chalk in any localit with which they may be acquainted. As the beds in the Kingsdown clif rise at a sharper angle than the general surface of the land, it is possib that the uppermost beds have more or less been sliced off by some denudin action towards Walmer Castle (to the right of the view, Plate VIII.).

Mr. S. P. Woodward informs me the chief characteristic shells of th highest beds of the Norwich chalk are—*Pecten concentricus*, *Ostrea larv* *Terebratulina gracilis*, *Terebratella elegans*, *Rhynchonella octoplicat* *Magas pumila*, and *Chama inæquirostrata*. The occurrence of these she in any locality will be therefore indicative of the presence of strata repr sentative of the Norwich beds. S. J. Mackie.

Didymodon Vauclusianum.—Since my memoir on this subject w published, the specimen has been thoroughly cleaned out by Mr. Davi of the British Museum, and he has distinctly shown that the interpretati that the last tooth in the jaw was the third molar, was erroneous. T tooth is therefore the second molar; the one immediately preceding it ing the first; and the fractured tooth, instead of being the first molar, tu out to have been the last premolar. The specific and generic distinctio the Didymodon is, however, not invalidated by the detection of this er on my part, which, as in all similar cases, I hope to be the first to point c

C. Carter Blake

Mammalian Remains in Hampshire Gravel.—The remains refer to at page 110, have been kindly forwarded to us by Lieut.-Colonel Nic

PLATE VIII.

UPPER CHALK CLIFFS ON THE SHORE BETWEEN WALMER CASTLE AND KINGSDOWN, KENT.

S. J. Mackie del.

es are—*Elephas primigenius* (determined by Dr. Falconer) in
ded lump of Tertiary rock, *Pectunculus Plumsteadiensis*, *Na-
ıeroides*, and *Rostellaria Sowerbii* (determined by Mr. Prest-
D. Geol.

Canoe.—The dredgings in the Seine have brought to light the
remains of a canoe fashioned of the trunk of a tree, 5½ mètres
85 centimètres broad in the middle, and attributed by the French
ns to the Gallic era. In the same place seventeen pieces of
ney, a knife, a flint axe, and various pieces of pottery were found
ie time.

)re.—A vein of lead-ore has been discovered at Port Jervis,
ounty, N. Y., containing 80 per cent. of pure lead, and six feet
ight feet deep, in the Oneida Sandstone.

lian Remains.—Dr. Buckland records, in the Geological So-
ansactions, vol. iv. p. 287, the discovery of "four large and
s of elephants," in a garden opposite the chalk pit at the base
it Hill, and on the north side of the turnpike-road. They were
ime (1817) in the possession of Mr. Lee, the owner of the ex-
ick-works there.

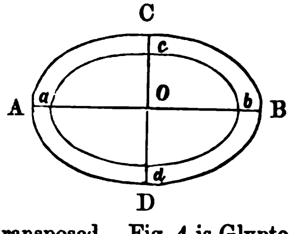
k Broads.—Sir,—I should be much obliged if you could inform
origin of our "Norfolk Broads." They are, as the name im-
d, comparatively shallow, sheets of water of various extent,
a few miles only from the sea, and partially overgrown with
I have myself a suspicion that they are in some way connected
rag sea.—Yours truly, Charles Jicks, jun.

t may be as well to add that the "Broads" above-named have, I
ways some connection with a tidal river.

ds, Thorpe, near Norwich, March 23.

bance of the Sea.—The 'Grahamstown Journal' (February,
es the following statement:—"A farmer named Elliott, residing
a River, while crossing the mouth of the Keiskama, a few days
ced an eruption in the sea, which was violently agitated and
vards as from the spouting of a whale. On approaching the spot
as possible, he perceived that a dense body of smoke rose as
ter, and when the tide threw the surf over the spot it was im-
thrown some forty or fifty yards into the air, the water, for the
nce of half a mile, assuming the colour of the blackest ink.
nued for some fifteen minutes, and gradually died away with a
sound."

.—Sir,—The note "On a Progressive Change in the Form of
," page 110 of the number for
I am sorry to find, unintelligible,
ience of the omission from the
f letters referred to in the text.
am ought to have been thus
George Hamilton.



College, Liverpool, March 8th, 1863.

.—Blackdown Greensand.—In
. Sidmouth and Lyme Regis are
ed as to positions.

.—In Plate III. figs. 4 and 5 are transposed. Fig. 4 is Glypto-
; fig. 5. Holoptychius scale.

in Table of Bird Remains.—The × to *Coturnix* is put in
richt instead of in the *Eocene* column, and the × to *Perdix* in
e instead of in the *Miocene* column; the ? to *Gallus* and the ?

to *Gallus Bravardi*, also, are put in the Eocene instead of the *Miocene* columns. *Lathornis ? emuinus* is also accidentally put in the Maestricht instead of in the *Eocene* column. Insert the × in *Pliocene* column against *Cygnus ferus*; and the × in *Cavern* column against *Falco*; and the × against *Gastornis Parisiensis* in the *Eocene* column; the × in the *Pliocene* column against *Cygnus ferus*.

REVIEWS.

Geological Observations on South Australia, principally in the district South-east of Adelaide. By the Rev. J. E. Woods, F.G.S., etc. 8vo. Longman. 1862.

We have in this book the results of an amateur geologist's well-directed observations on the geological structure of a considerable portion of South Australia during his residence there as a missionary, actively employed, and both willing and able to find occupation and amusement, during his leisure hours and solitary rides, in studying nature and the physical features of the country. The chief geological feature of the south-eastern portion of South Australia is a wide-spread limestone, mostly white and friable, composed largely of Bryozoa, especially of a large Cellepora (*C. gambieriensis*, Busk). The upper part of the limestone is often compact and without fossils, and it passes by degrees into the lower softer bed, which is full of Bryozoa, Terebratulæ, Pectines, and other bivalves, with numerous Gasteropods (chiefly casts), several Echinoderms, Shark-teeth, etc. The author gives a full account of this limestone, its flint-layers, iron-pyrites, rock-salt, and fossils; and remarks that, though it has some characters in common with the white chalk of England, yet it is really to be compared with the Suffolk Crag. He ascribes the origin of this deposit to a great reef, or reefs, of Bryozoa, such as have given given rise also to the Maestricht chalk and the Crag of Suffolk; but in explaining the natural history of such a reef, Mr. Woods has very unfortunately confounded "corallines," "corals," and "moss-corals" (partly by intent, and partly for want of exact zoological knowledge), to such an extent, that few of his non-scientific readers (to whom he particularly addresses himself) will understand that "corallines" are really stony seaweeds or algæ; corals, humble animals, but little raised above the sponge families; whilst moss-corals or Bryozoa (termed also Polyzoa) rank higher in the animal scale, and belong to a very different group. The external resemblance of certain Bryozoa to corals, long ago led some geologists to regard the lower Crag of Suffolk as being made up of "corals," and to give it the name "Coralline,"—a word which already had another meaning in connection with the calciferous Algæ. As neither corals nor corallines occur (or but very rarely) either in the Suffolk or the South Australian Crag, "coralline" must be a misnomer for either of them; and we hope that Mr. Woods will recollect this if his work comes to a second edition, as we hope it will. Some of the fossils of the white limestone under notice are illustrated by indifferent woodcuts; we trust that Mr. Woods will find some opportunity of having all his fossils carefully figured and determined by some working palæontologist. Mr. Busk has examined and named some of the Bryozoa (p. 81); the Foraminifera have been determined by Mr. Jones, of the Geological Society (p. 71); and Professor M'Coy seems to have examined others of the fossils; Mr. Woods, therefore, has made some progress in the elucidation of the palæontology of the interesting formation which has ccupied his attention with such good results as the book before us bears witness to. This book, written far away from libraries and museums, at Penola, in the South Australian bush, not only gives evidence of its author's good judgment in choosing geological research as means of intellectual amusement, of his extensive reading, his acuteness of observation, and sensible generalizations, but it is a good example of what may be done in rendering a geologist's knowledge of one locality available to neighbours and to the world at large. Without aiming at a high scientific standing (for which indeed its many verbal errors in nomenclature, and its scientific shortcomings, unfit it), this work will do good service both in the Colonies and at home. "In the former, the number of scientific readers is comparatively few, though in no parts of the world perhaps is a greater interest felt in matters of the kind," says the author; and indeed, what with their gold-seeking, water-seeking, and coal-seeking, their search for building-materials, their road-makings, etc., our colonial brethren may well have occasion to be alive to scientific subjects, and to geology in particular.

There is very much relating to the extinct volcanos of South Australia, and to the caves and their bone-breccias, to be found in Mr. Woods's interesting book; for all of these have their place in the geological history of the limestone tract which the author more particularly works out. In the late Tertiary period the Bryozoa had it all their own way here, in a hollow sea-bed, and rivalled corals in the accumulation of extensive reef-like deposits of calcareous matter, until volcanic agency interfered for awhile, to be succeeded by the deposits of shelly matter by ocean-currents for a long period, followed by a perhaps longer era of upheaval and slow denudation, accompanied by other volcanic disturbances; the extinct craters due to this are still existing. The upheaved Bryozoal limestone weathers into arid sand; it is also extensively excavated by subterranean water-channels, supplying the local wells to a large extent.

These changes have been gradual, the author thinks; and during that long time the marine fauna was considerably changed, but the terrestrial fauna in a less degree.

The author has some useful observations, in his early chapters, on the relation of physical geography to geological conditions, and on the general physical character of Australia. His description of the soil, swamps, vegetation, and faunal peculiarities of the district in which he interests himself, affords many useful hints to the palæontologist as to local accumulations of minute organisms, of certain lake-shells, and of mammalian bones. The "Biscuits-flats" of Southern Australia have long puzzled those who have seen them; but Mr. Woods explains the origin of the calcareous "biscuits," by showing that these round flat plates are really the sun-dried marly cakes that have been formed in little depressions of the ground in the rainy season (p. 45).

We hope that this highly interesting and well-constructed work will fulfil its object as an instructive book among the public fully as well as it served, whilst in preparation, to amuse its solitary, hard-working author in the Bush.

Studi Stratigrafici e Paleontologici sull' Infralias nelle Montagne del Golfo della Spezia; del Prof. Giovanni Capellini. 4to. Bologna. 1862.

The Lower Liassic formations of the neighbourhood of Spezia have been long interesting to British geologists, the labours of De la Beche and Murchison having rendered them to a certain extent familiar to us. The excellent memoir which Prof. Capellini has produced gives an elaborate catalogue of the fossils of the *calcare nero*, and the associated schists of the vicinity.

COMPARATIVE TABLE OF THE PRINCIPAL LOCALITIES OF THE SPECIES OF MOLLUSCA COMMON [illegible] THE LOWER LIAS OF SPEZIA.

[illegible]pecies met with in the hills of the Gulf of Spezia, and the neighbouring islands of Palmaria, Tiro, and Tiretto.	Lombardy.	Hettange.	Rodano.	Ardèche.	Isère.	Moselle.	Semur, Côte d'Or.
[illegible]mmonites nanus ?, *Mart.*	...	...	...	...	...	...	*
[illegible]urpurina spediensis, n. sp.	...	...	...	...	...	...	...
[illegible]eritopsis tuba, *Schafh.*	*	...	...	...	...	...	...
N. Paretii, n. sp.	...	...	...	...	...	...	...
N. bombicciana, n. sp.	...	...	...	...	...	...	...
[illegible]hemnitzia usta, *Terq.*, sp.	...	*	...	...	...	...	...
C. abbreviata, *Terq.*, sp.	...	*	...	...	...	...	...
C. turbinata, *Terq.*, sp.	...	*	...	...	...	...	...
C. unicingulata, *Terq.*, sp.	...	*	...	...	...	...	...
C. incerta, n. sp.	...	...	...	...	...	...	...
C. Cordieri, n. sp.	...	...	...	...	...	...	...
C. acutispirata, n. sp.	...	...	...	...	...	...	...
C. Lessoniana, n. sp.	...	...	...	...	...	...	...
[illegible]erithium semele, *Mart.*	...	...	*	...	*	*	*
C. Henrici, *Mart.*	...	...	...	...	...	...	*
C. rotundatum, *Terq.*	...	*	...	...	...	...	...
C. gratum, *Terq.*	...	*	*	*	*	...	...
C. Meneghinii, n. sp.	...	...	...	...	...	...	...
C. sociale, n. sp.	...	...	...	...	...	...	...
[illegible]urritella Dunkeri, *Terq.?*	...	*	*	*	*	...	...
T. Zenkeni, *Terq.*	...	*	...	...	...	...	...
T. Deshaysea, *Terq.*	...	*	*	*	*	...	...
T. bicarinata, n. sp.	...	...	...	...	...	...	...
T. Somervilliana, n. sp.	...	...	...	...	...	...	...
T. lunensis, n. sp.	...	...	...	...	...	...	...
[illegible]urbo subpyramidalis, *D'Orb.*	...	...	...	...	...	...	...
[illegible]hasianella nana, *Terq.*	...	*	*	*	*	...	...
P. Guidonii, n. sp.	...	...	...	...	...	...	...
[illegible]rthostoma Savii, n. sp.	...	...	...	...	...	...	...
O. triticum, *Terq.*	...	*	...	...	...	...	...
[illegible]orbula imperfecta, n. sp.	...	...	...	...	...	...	...
[illegible]natina præcursor, *Quenst.*, sp.	...	...	...	...	...	...	...
[illegible]holadomya sp.	...	...	...	...	...	...	...
[illegible]yacites faba, *Wink.*	*	...	...	...	...	...	...
[illegible]actra securiformis, *D'Orb.?*	*	*	...	...	...	...	...
[illegible]starte cingulata, *Terq.*	...	*	...	...	...	...	...
A. Cocchii, *Mgh.*	...	...	...	...	...	...	...
A. Pillæ, n. sp.	...	...	...	...	...	...	...
[illegible]ardinia regularis, *Terq.*	...	*	*	*	*	...	...
C. trigona, *D'Orb.*	...	...	...	...	...	...	...
C. angulata, n. sp.	...	...	...	...	...	...	...
Total	3	14	6	5	6	1	3

Species met with in the hills of the Gulf of Spezia, and the neighbouring islands of Palmaria, Tiro, and Tiretto.	Lombardy.	Hettange.	Rodano.	Ardèche.	Isère.
Brought forward	3	14	6	5	6
Cardinia Stoppaniana, n. sp.	...	...	...	...	...
Myoconcha psilonoti, *Quenst.*	...	...	...	...	...
Cardita munita, *Stopp.*	*	...	...	...	...
C. Austriaca, *Hauer*, sp.	*	...	...	...	...
C. tetragona, *Terq.*	...	*	...	...	...
Lucina Civatensis, *Stopp.*	*	...	...	...	...
Corbis depressa, *Romer*, sp.	*	...	...	...	...
Cardium Regazzonii, *Stopp.*	*	...	...	...	...
Myophoria lævigata, *Broun*, sp.	...	...	...	...	...
Cucullæa acuta, *Mgh.*, sp.	...	*	...	...	...
C. Murchisonii, n. sp.	...	...	...	...	...
C. Castallanensis, n. sp.	...	...	...	...	...
Nucula subovalis, *Gold.*	*	...	...	...	...
N. ovalis, *Ziethen.*	...	...	...	...	...
N. strigillata, *Gold.*	...	...	...	...	...
Mytilus cuneatus, *Sow.*, sp.	...	...	...	...	...
Lithodomus Lyellianus, n. sp.	...	...	...	...	...
L. Meneghinii, n. sp.	...	...	...	...	...
Avicula Deshayesi, *Terq.*	...	*	...	...	...
A. Buvignieri, *Terq.*	...	*	...	...	...
A. Dunkeri, *Terq.*	...	*	...	...	...
A. Alfredi, *Terq.?*	...	*	...	...	...
A. infraliassica, *Mart.*	...	...	...	...	...
A. Sismondæ, n. sp.	...	...	...	...	...
A. Meneghinii, n. sp.	...	...	...	...	...
A. inæquiradiata, *Schafh.*	*	...	...	...	...
Pecten Falgeri, *Mer.*	*	...	...	...	...
P. janiriformis, *Stopp.*	*	...	...	...	...
P. aviculoides, *Stopp.?*	*	...	...	...	...
P. Sismondæ, n. sp.	...	...	...	...	...
Lima punctata, *Sow.*	*	*	...	...	...
L. Azzarolæ, *Stopp.*	*	...	...	...	...
L. nodulosa, *Terq.?*	...	*	...	...	...
L. præcursor, *Quenst.*	...	...	...	...	...
L. pectinoides, *Sow.*, sp.	...	...	...	...	...
Spondylus Hoffmanni, n. sp.	...	...	...	...	...
Plicatula interstriata, *Emm.*	*	*	*	*	*
P. Mortilleti, *Stopp.*	*	...	...	...	...
Rhynconella Pillæ, *Mgh.*	...	...	...	...	...
R. Portuvenerensis, n. sp.	...	...	...	...	...
Total	17	23	7	6	[illegible]

The following table of the divisions of the Lower Liassic beds in Italy, France, Belgium, England and Germany will be found useful.

Lias	. . . . . . *Calc.* à Gryphées arquées.	. . . . . . *Calc.* à Gryphées.	. . . . . . Limestones, *G. arcuata* and *A. Bucklandi.*	. . . . . . Starhemberg-Gres tener-Schichten.		. . . . . Formazione di Saltrio.	Lias. Schisti calcarei nerastri con Belemniti.	Lias. ?
LOWER LIAS BEDS. Upper.	*Grès calc. ou grès d'Hettange et de Luxemb. (Pierre bise ou foie-de-veau de Martin).* *Calcaire grèso-bitumineux.*	Zone à *Amm. Moreanus*, Foie-de-veau.	White Lias, with *A. planorbis* and *A. Johnstoni.*	Dachsteinkalk.	Kalk mit *Megalodon scutatus*, Schaf.	Dolomia superiore di Lombardia.	Calcare dolomitico e marmo portoro dei monti Castellana, Coregna, Murlo, Rocchetta, ecc.	?
LOWER LIAS BEDS. Lower.	*Bone-bed.* Grès cristallin micacé ou grès de Helmsingen et de Lœvelange.	Zone à *Amm. Burgundiæ*, Lumachelles. Zone à *Avicula contorta*, Arkoses.	*Bone- bed* of Axmouth, Austcliff, Watchet, Wainlod cliff, etc.	Kössener-Schichten.	Oberes. S. Cassian.	Deposito dell' Azzarola e banco madreporico. Gruppo delle lumachelle e degli schisti neri marnosi.	Calcare nero e schisti fossiliferi di Grotta Arpaja, Tiro e Tiretto. Calcare grigio e schisti a Bactryllium del Pescino, Parodi. Calcare fettucciato, Bianca; schisti a Bactr.	Calcare fossilifero della Tecchia, ecc., delle Alpi Apuane. Calcare grigio-cupo senza selce fossilifero di Caprona, Asciano, S. Giovanni alla Vena nei Monti Pisani.
Upper Trias .	Marnes irisées.	Marnes irisées.	(Keuper-)New Red Marl.	Dolomite. Hallstätter-Schichten (Esino Kalk). Raibler-Schichten and S. Cassianer Schichten (Lombardia).	Hauptdolomit. Petref. von Esino. Keuper (Letten-kohle. Bunte Mergel.)	Dolomia media. A. Dolomia media propriamente detta. B. Petrific. d' Esino. C. Gruppo di Gorno e Dos-	Calcare cavernoso di S. Benedetto, S. Bartolommeo, Bianca, etc. Breccia di schisti del Verrucano, a S. Terenzo, Lerici,	Calcare cavernoso. ?

Geologia e Paleontologia del Bolognese; Cenno Storico del Prof. G. Capellini. 8vo. Bologna. 1863.

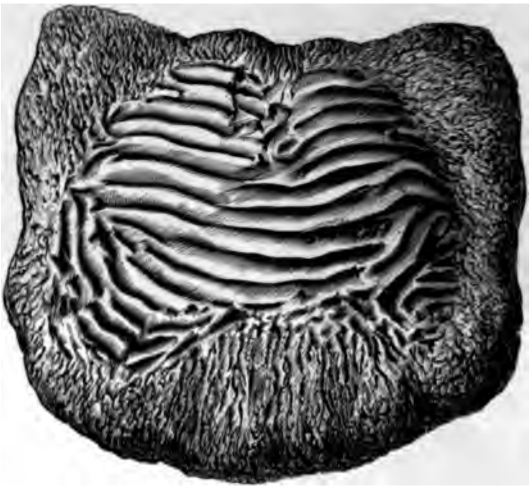
This is a history of the progress of geology and palæontology in the neighbourhood of Bologna from 1648 to 1810. The Aldrovandine Museum first gave an impetus to the study of palæontology in Italy, and many of its choicest specimens were described by Ambrosini in his 'Museum Metallicum.' Here under the name of *Argyroconchus* was for the first time figured a fossil shell frequent in all the Bolognese hills, which Scheuchzer in a later period termed *Concha polygynglima*, Lamarck *Perna maxillata*, Deshayes *Perna Soldani*. Lorenzo Legati in a part of his work (1677) denied that the Glosso-petro had formed part of an animal, but elsewhere admitted its resemblance to the tooth of the shark. The labours of Ghedini, Beccari, and Monti are alluded to by Prof. Capellini, as well as the researches of Dr. Falconer, who has shown the distinction between the rhinoceros of Monte Biancano (*R. leptorhinus*, Cuv. part) and the species from Val d'Arno described as the *R. Etruscus* of Falconer.

The memoir is of a most interesting nature, and although the present political condition of Italy is such as to inspire but little hope for scientific progress there, the above-mentioned works by Prof. Capellini are valuable and accurate contributions to this science.

Balenottera Fossile nelle Argile Plioceniche di S. Lorenzo in Collina (Provincia di Bologna). Nota del Prof. G. Capellini. 8vo. Bologna. 1862.

This little pamphlet details the progress of a journey made, and brief notices of the fossils collected by Professor G. Capellini, Drs. Foresti and Nicolai, in the neighbourhood of Bologna. The most striking fossil which was obtained was referable to the genus *Rorqualus*, of which a portion of mandible, being about a metre and a half in length, was at first discovered, and led to the identification of the species. Afterwards the skull, the maxillary bone, and one of the mandibles, doubtful evidence of a paddle, and portions of vertebræ and ribs, were found. Deductions from these evidences lead Professor Capellini to the inference that the whale to which it belonged measured at least 68 feet in length. He speculates on the future discovery of the remains of dolphins, rhinoceroses, elephants, and other mammalia that inhabited the same region during the Pliocene epoch. In a note he reminds palæontologists that besides remains of rhinoceroses which exist in the museum at Bologna, there is also a fine molar of *Elephas antiquus*, derived from Crovara, and which forms part of the fossils collected by Professor Alessandrini. A few fragments, referable to the same species, from the same locality were discovered in a shop, where a piece of a broken mandible had also been preserved in a bad state.

We are glad to see that Professor Capellini is endeavouring to remove the stigma which has been cast upon Italian geologists, of not paying due attention to the productions of their own country.



PTYCHODUS POLYGYRUS, Agassiz.

From the White Chalk of Kent.

[In the Collection of N. T. Wetherell, Esq., of Highgate.]

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THE GEOLOGIST.

MAY 1863.

CESTRACIONT FISHES OF THE CHALK.

BY THE EDITOR.

THE very fine specimen of palatal tooth of *Ptychodus polygyrus*, which we figure in Plate IX., from the collection of N. T. Wetherell, Esq., of Highgate, temporarily draws our attention to a class of remains of very considerable interest.

We have not the leisure at the present time for going as deeply into the subject as it well deserves, nor as the mass of valuable materials accumulated since the publications of Agassiz in 1843, and Dixon in 1850, require.

There are also other important points than the mere bearings of more detailed information of the characters of species very possibly to be gained by a study of the singular and marked group of cestraciont fishes. First known, in abundance of individuals, in the Carboniferous age—though not at any time numerous in genera,—and presenting various forms, numerically abundant, in the Jurassic and other intermediate formations up to the Chalk, characterized by its many varieties of Ptychodus, but now dwindled down to a solitary representative in the Port Jackson shark, it is one of those very circumscribed groups in which we ought to find more especially and distinctly marked traces of the transmutation of one species into another, if such transmutation did exist in the past ages of our planet. That the group does present important evidence on this point is certain, but whether sufficient or not to come to a practical and definite conclusion, may be as yet doubtful; although, if collectors will turn to the fossil remains of these fishes in earnest, we may rest assured of good work in this direction being done. By a glance at the British Museum specimens, and a careful looking over of the descriptions and figures in the 'Poissons Fossiles' and the 'Geology of Sussex,' any intelligent observer would at once see what new additions would be useful for supplying the missing links in the historic and stratigraphical series. We add here a list of the species of Ptychodus exhibited in our National Collection.

SPECIES OF PTYCHODUS IN BRITISH MUSEUM COLLECTION.

PALATAL TEETH OF	
Ptychodus polygyrus . . .	From White Chalk, Burham, Kent, Wiltshire, Lewes, Sussex, Purfleet, Grays, Essex (Taylor's Collection).
Pty. depressus	White Chalk of Cherry Hinton, Cambridgeshire.
Pty., n. sp.	White Chalk (Taylor's Collection).
Pty. Oweni	White Chalk, Burham, Lewes.
Pty. Mortoni	Cretaceous strata, Clarke County, Alabama.
? *Pty.* (specimens called nascent teeth)	Lower Chalk, Dover, Sussex.
Pty., sp. (near *polygyrus*) . .	Upper Greensand, Tournay.
Pty. rugosus	White Chalk, Rochester, Greenhithe, Kent.
Pty. altior	Chalk, Sussex,
Pty. decurrens	Lower Chalk, Kent (Taylor's Collection), Harietsham, Burham, Maidstone, Kent, Brighton.
Pty. mammillaris	Lower Chalk, Lewes, Brighton, Dover, Guildford; Upper Greensand, Tournay; Chalk Marl, Töplitz.
FIN RAYS OF	
Ptychodus spectabilis . . .	White chalk, Lewes.
Pty., sp, (small size) . . .	Chalk, Sussex.
Pty. arcuatus	Chalk, Lewes.
Pty. cibberulus	Chalk, Lewes.
ty. articulatus	Chalk, Lewes.
Pty., sp.	White Chalk, Burham.
Pty. latissimus	White Chalk, Herts, Lewes, Kent, Southeram; Cretaceous deposit? at Oxford, Essex.
Pty. paucisulcatus	Chalk, Sussex.

In the same cases with the Ptychodus teeth is a tooth of *Strophodus asper*—the type specimen figured by Agassiz. There are also some other specimens and fragments of Strophodus, to which genus I am disposed to add the specimens and fragments labelled "nascent teeth of Ptychodus," and so styled in Dixon's work by Sir Philip Egerton. A comparison of the structure of one specimen in particular, with one of the specimens of *S. magnus* from the Stonesfield Slate of Eyeford, in the adjoining case will, we think, justify this view. Without wishing to do more than hint the possibility that the ancestors of *Pty. Mortoni*, from the American Greensand, may be represented in time by some of the species of Acrodus, we would invite comparison with an unnamed tooth of this genus from the Forest marble of Stanton, in Wiltshire. In the same way, if the development theory be correct, the connecting links might be hereafter discovered between the more primitive *Orodus ramosus* of the Carboniferous limestone and the Forest Marble species of Acrodus, and the *Acrodus Anningiæ* of the Lias of Lyme Regis.

NOTES ON THE EVIDENCE OF GLACIAL ACTION IN SCOTLAND.

By P. Simmons, Esq., of Whiteinch.

In the parish of Baldernock, county of Stirling, and in the neighbourhood of "fragments of stone reared by creatures of clay," Craigmadden Castle, the pedestrian will find three large stones well worthy of his notice. They are situated in the centre of a bog; consequently, if the said pedestrian desires to observe, measure, and minutely examine them, he must, as three friends lately did, take off boots and stockings and wade through the water that surrounds the stones to within two feet; that is to say, if he desires such articles to remain dry. The bog forms part of an extensive natural amphitheatre, situated in the Craigmadden moor; and the stones have received the name "Auld Wives' Lifts," from the absurd tradition that they were placed, once upon a time, among the heather by three old women, natives of Baldernock, Strathblane, and Campsie.

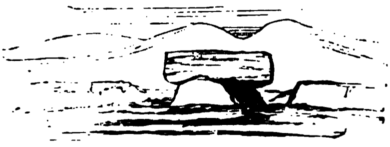

Fig. 1.—View (looking to the S.E.) of the "Auld Wives' Lifts."

The Lifts are considered by some antiquaries to be nothing more or less than a cromlech or sepulchral monument; others, however, think they are an altar which the Druids used. The former opinion is maintained by Dr. Daniel Wilson in his 'Archæology.' His words are: "It is remarkable as an example of a trilith, or complete cromlech, consisting only of three stones. Two, of nearly equal length, support the huge capstone; a block of basalt measuring fully 18 feet in length, by 11 in breadth, and 7 in depth. A narrow triangular space remains open between the three stones, and through this every stranger is required to pass on first visiting the spot, if, according to the rustic creed, he would escape the calamity of dying childless. It is not unworthy of being noted, that though the site of this singular cromlech is at no great elevation, a spectator standing on it can see across the island from sea to sea; and may almost at the same moment observe the smoke from one steamer entering the Frith of Clyde, and from another below Grangemouth, in the Forth." The view engraved by Dr. Wilson is from the south-east; and, according to his measurement, the weight of the large sandstone, not basalt, capstone is 96 tons; being 46 tons more than a different result of the measuring, which makes the weight 50 tons. The two fragments of sandstone on which this large piece rests are prismatic in shape, lying side by side, forming a triangular opening, which enables any one to creep through. The sketch of the stones as seen from the south-west, gives the reader an idea of the size of this space. In the appendix, No. 4, to Mr. Smith's recently published 'Researches in Newer Pliocene Geology,' Mr. Buchanan considers the Lifts "a very interesting and well-preserved memorial of the remote pagan people of the canoe period," and, like Nilsson, states that "the uppermost is an enormous block of basalt." This mistake causes one to imagine that the stones have not been properly examined by the said antiquaries. The Lifts are covered with the marks made by visitors and others. Their position according to the compass may be useful, and is consequently here given, as taken from the capstone.

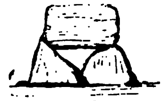

Fig. 2.—End view of the "Lifts."

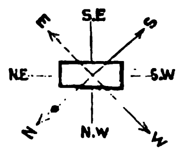

Fig. 3.—The bearings of the "Lifts."

The science of geology enables the unprejudiced observer to declare with boldness, and to prove beyond doubt, that the Auld Wives' Lifts were never placed where they now are by demons, angels, witches, or mortals, of any age. Although, to quote Kent's well-known lines,—

> "There's a pleasure on the heath
> Where Druids old have been,
> Where mantles grey have rustled by
> And swept the nettles green,"

yet science compels us to give to water and ice the honour of causing the three stones to remain where they now are. They are erratics. This fact, for the evidence is almost demonstrative, is asserted by one who has made frequent visits to the stones, and a careful examination of the strata in their neighbourhood. The former are angular; "the erratic blocks," Agassiz asserts, "in Switzerland are always angular;" the latter is composed of sandstone and conglomerate or pudding-stone. The sandstone is both polished and grooved, frequently cut and excavated by some force, doubtless ice. The ice appears to have been aided by a current, which, sweeping along, made the sandstone yield. This ice current appears to have cut the sandstone fragment lying on the margin of the bog to the south-east of the Lifts.

Fig. 4.—Sandstone block, S.E. of the "Lifts."

The stones have been floated to their present position by ice, at a time when the land was depressed by some earthquake movement. "We have," says Mr. Smith, of Jordanhill, in his most interesting 'Researches,' "in the superficial beds in the basin of the Clyde evidences of such a movement, which must have taken place in the period when the climate was colder than at present, and which, if not paroxysmal, was sufficiently rapid to have entombed alive the testaceous inhabitants of the sea, and to have covered them up to a considerable depth with beds of finely laminated clay, which could only have been formed at the bottom of the sea." The current or rush of water made the ice bearing the erratics cut and polish the sandstone in the neighbourhood. This rush of water was doubtless produced by one of those earthquake waves thus described by Mr. Smith in the above-mentioned work, and considered by him to be the force that originated the till or boulder clay:—"A rush of water, such as that produced by earthquake waves, of sufficient violence to tear up, not only the pre-existing unconsolidated cover, but considerable portions of the subjacent rocks, and perhaps obliterate the inequalities caused by disturbances in the coal measures, passed over the island from west to east, or, rather, from the north-west, depositing the whole in a confused mass on the surface. In that part which was under the sea, beds of gravel, sand, and clay were deposited. In process of time, a second débâcle swept over the island in the same direction, but with much less violence than the first; the stratified beds, perhaps of no great thickness, were swept away, leaving, however, occasional patches sufficient to attest their existence, and also part of the pre-existing diluvium, reducing the inequalities and grinding the exposed surfaces of the rocks and boulders, for it is to this second débâcle I ascribe the scratching of the rocks and boulders; and here, I think, ice acted an important part, and was probably the principal agent in grinding down the substance over which it passed. A colder climate and a north-west direction both point to a frozen ocean, which was perhaps broken up by the convulsion which caused the diluvial wave, and the ice of which was swept over the land in the same direction." Antiquaries formerly imagined the erratics, or the boulders termed rocking stones, to be the workmanship of human hands; now however, Mr. Wright, one of the most talented of their number, asserts that they are the result of natural causes. Geology has proved this; and the same science has also taken from the territory of archæology some of the stones said to be complete cromlechs, the Lifts being an instance.

When examining the boulders near Loch Ken in Kircudbrightshire, I observed among many of great size and gigantic in composition, one 10 feet in height, and 13 feet 9 inches long, resting on two small boulders, prismatic in form. (See sketch.) Workmen were blasting some of the boulders when I was measuring, consequently their number is decreasing; and the evidence of glacial action in the neighbourhood of Loch Ken, as far as boulders are concerned, will soon cease to exist. This, however, cannot be said of the striking glacial action

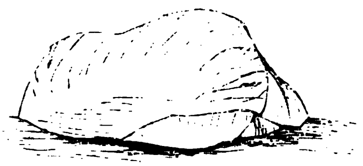

Fig. 5.—Boulder near Loch Ken.

observed on the banks of Loch Doon, in Ayrshire, as the remarkable striated trap-rocks cannot be so easily removed. The openings or striæ are generally narrow, long, and deep; sometimes prismatic. They appear to resemble in sharpness the scratchings considered, by Dr. John Tyndall, in his published 'Description of the Glaciers of

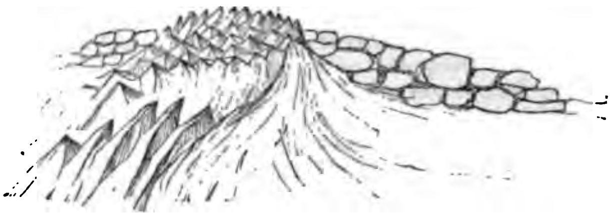

Fig. 6.—Striated basalt, Loch Doon (as seen from the Lake).

the Alps,' to be caused, on the Riffelhorn, by the Görner glacier of former ages. The boulders on the shores of Loch Doon are frequently very large, and mostly basalt; and so numerous, as to constitute entirely the west side of the loch, the waters of which appear to rest on a bed of boulders, four of which are so large as to appear above the surface, and now remain islands. (See sketch.) None of the numerous

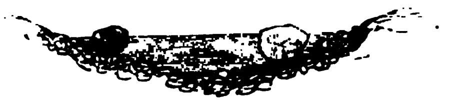

Fig. 7.—Island-boulders, Loch Doon.

boulders examined by me possess the strong and varied polarity which Dr. Tyndall found to exist in some cast down from the summit of the Riffelhorn. It is not maintained that the many trap-boulders scattered through Scotland were never magnetic; and it is only affirmed that no fragment has yet been discovered that was observed to act forcibly upon a magnetic needle. It may be here remarked, that many of the "jutting prominences" of Dumbarton basalt rock, on which the fortress is situated, like those of the Riffelhorn and Görner Grat, described by Dr. Tyndall, possess the magnetic action caused by the magnetic oxide of iron. Has this magnetism been developed by glacial action?—is a question which cannot be here answered, although it is one worthy of being considered by geologists. The top and base of Dumbarton Rock I have examined with a small compass. Near the summit of the portion of this rock called the beacon-tower, the polarity changed, the pole affected being the south, at the distance of 34 inches. In no instance did I observe the compass to be affected in the east portion of the rock, either at the top or base; the reverse was the case with the west portion, both at the top and base, the immense fragments, undoubtedly portions of the rock, removed probably, by lightning, on the terrace at the foot of this part of the rock, being no exception to the "strong and varied polarity."

Glacier pressure is considered by Dr. Tyndall to cause the crust observed on trap, or rather the species of trap termed basalt. In the 143rd page of his 'Glaciers of the Alps,' he says, in describing the lower spur of the Riffelhorn: "Midway down the spur I lighted upon a transverse wall of rock, which formed in earlier ages the boundary of a lateral outlet of the Görner glacier. It was red and hard, weathered rough at some places, and polished smooth at others. The lines were drawn finely upon it, but its outer surface appeared to be peeling off like a crust; the polished layer rested upon the rock like a kind of enamel. The action of the glacier appeared to resemble that of the break of a locomotive upon rails; both being cases of exfoliation brought about by pressure and friction." This crust is observed on basalt boulders taken out of semicircular mounds, probably caused by glacial action; portions of the crust can easily be removed. My illustrious and valued friend Mr. James Napier, F.C.S., in his valuable "Remarks on Mineral Veins and Waterworn Stones," read before, and published in the Transactions of the Philosophical Society of Glasgow, March 3rd, 1852, has proved, beyond doubt, that this crust is not the result of pressure but of water. This eminent chemist maintains that water, in contact with and passing through rocks, changes their character, by dissolving out some of their component minerals. The following extract, although long, I cannot refrain from giving, as it clearly explains how the remarkable crust found to exist on trap or basalt rocks originates :—

"A piece of trap rock, *e.g.*, exposed to water, very soon changes, when alternately wet and dry, and exposed to the atmosphere; the decomposition is sensibly apparent, a brown crust is soon formed, which becomes soft and brittle, breaking off by slight friction, leaving a new portion of the stone to undergo the same change. The same sort of stone embedded in the gravel under the soil, passes through the same changes, but the crust in this case is not so soft and brittle; the change soon penetrates to the centre of the stone, giving it a different character and appearance." I lately removed portions of the crust from such boulders, taken from a railway cutting in this neighbourhood, almost half an inch thick, and about 12 inches by 6. Much larger fragments could easily be obtained. "Analysis," continues Mr. Napier, "of the stone so changed, compared with the original, makes the change very apparent. We give the average of many analyses from different localities :—

Kernel, or original stone.			Crust, or altered stone.		
Insoluble silicate of alumina	66·8		Insoluble matter	72·5	
Protoxide of iron	18·5	Fe 14·4	Peroxide of iron	19·7	Fe 13·8
Lime	3·8		Lime	0·9	
Magnesia	1·5		Magnesia	0·3	
Potash	2·6		Potash	trace	
Loss at red heat, water	6·2		Loss at red heat	5·1	
	99·4			99·2	

"Here, then, we find that water has dissolved out lime, iron, magnesia, and potash, and the remaining iron changed to the peroxide state. The length of time required for the water to penetrate a piece of trap I know not; but that the soluble power of the water is great, is evident, by placing a piece of such rock in distilled water; 100 grains digested for six days, at summer heat, lost one per cent.: the water had an alkaline reaction, and contained magnesia, potash, and lime." Mr. Napier exhibited a specimen of a boulder, showing "the powerful action constantly going on in the earth, changing the character of rocks;" and he also remarks, that "the crust or outer portion of stones of this soil have generally been looked upon as incrustations, from the water in which they have been placed having salts in solution that have become deposited upon the stone or kernel portion. Such incrustation does take place upon organic substances placed in mineral waters; but in this instance, as in most other minerals, the change has evidently been caused by the decomposition of the original stone."

Not far from the town of Lochwinnoch, on the road to Kilbarchan, in which parish it is situated, stands one of the most remarkable erratics in the west of Scotland. Mr. William Fulton, M.A., Govan, first informed me of its existence, and last July both of us measured it. The immense basalt fragment, judging from the direction of the deep and broad scratches on its south-east side, appears to have been carried along in two directions; the force, either ice or running water, thus causing the marks or scratches to cross one another almost at right angles. (See sketch.) The stone is 11 feet in height and about 69 feet in circumference, and appears to be two miles west of the town of Kilbarchan. The stream called St. Bride's Burn is not very far from the erratic, which receives the local name Clochodrickstone, said to be from the Gaelic, meaning the Druid's stone.

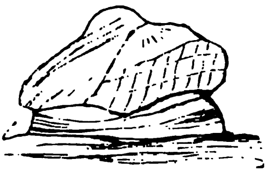

Fig. 8.—Erratic block, Lochwinnoch.

AN ATTEMPT TO CORRELATE THE GLACIAL AND POST-GLACIAL DEPOSITS OF THE BRITISH ISLES, AND TO DETERMINE THEIR ORDER OF SUCCESSION.

By Professor William King,

Of the Queen's University, Ireland, and the Queen's College, Galway.

The classification given in the sequel is based on the following premises:—

1st. The entire area of the British Isles has undergone at different times, during the Glacial and Post-Glacial periods, a succession of secular elevating and subsiding movements.

2nd. At the close of the Pliocene period, the relative level of land

and sea over the British area was approximately the same as at present.

3rd. The edge of the two-hundred-fathoms submarine plateau, on the east side of the North Atlantic, formed the west coast-line of a continent (now represented by Europe) during the earliest time (epoch) of the Glacial period.

4th. The climate of the British area was frigid in the extreme during the Glacial period, allowing epochs of amelioration.

5th. Rock-surfaces undergo enormous degradation when they are above the sea-level, during the prevalency of glaciation.

General Observations on the above.

1st Premiss. Besides the great vertical movements which characterized the Glacial period, there are evidences, hereafter noticed, that it was marked by minor vertical oscillations. Further, it is probable that the former were not of equal magnitude over the entire area of the British Isles; land might be standing somewhat higher or lower in the east than in the west; the same difference may have prevailed meridionally.

2nd. The "Cromer Norway Spruce-forest" bed evidently formed a land-surface at the close of the Pliocene period; while the overlying "Runton *Leda myalis* clay" shows that the forest-bed became afterwards submerged. Further, the shells occurring in the Runton deposit may be accepted as a clear proof that the sea in which they lived was Arctic in its temperature; the same may be affirmed of the "Norwich Crag" sea. There is no novelty in these conclusions. Doubtless the elevated regions of the British area, during the prevalency of the Pliocene Arctic temperature, were undergoing glaciation. It is equally admissible that the then German Ocean was traversed by icebergs, transporting blocks from northern latitudes. These considerations lead me to assume that the foreign erratics, common in the unstratified drift or till of the north of England and the more southern counties, are *Pliocene* in age, and that they afterwards became mixed with lowland accumulations of field- and mountain-glacier débris, formed during the earliest division of the Glacial period, that is, when the bed of the German Ocean was all a terrestrial surface. I doubt that any Pliocene foreign erratics are anywhere to be seen under their original form of accumulation.

3rd. My late investigations on the soundings obtained by H.M S. Porcupine* have convinced me that the remarkable rapid-sinking edge of the two-hundred-fathoms submarine plateau, forming the Irish sea-bed, as well as the extension of this edge, both north and south, has been cut away by the North Atlantic when its waters were confined within the bounding meridians of the two-miles-deep submarine plain, across which it is proposed to run the telegraph cable from Ireland to Newfoundland. Geological evidences go far to prove that the above

* See my papers in the 'Nautical Magazine' of November and December, 1862 (a corrected copy of which appeared in the 'Daily News' of December 24, 1862); also my "Reply to Dr. Wallich's Statements," Naut. Mag., March, 1863.

oceanic conditions prevailed in the earliest epoch of the Glacial period. Mr. Godwin-Austen has already enunciated a similar opinion.*

The Irish submarine plateau is bounded by sloping sides, which generally sink down to about 10,000 feet, or nearly 1700 fathoms, before reaching the general level of the plain alluded to, with an inclination ranging from 400 to 1000 feet in the mile; the lowest being off Galway (Hoskyn), and the highest on the coast of Kerry, where, however, there is also a 548-feet incline. The surface of the plateau appears to be marked by three terraces of different levels. *First.* The outer edge of this, the lowest terrace, is not naturally defined by the 200-fathoms line, as one of the names of the plateau seemingly implies, but rather by one of 220 fathoms; as it is from the latter line that the most sudden descent is made into deep water. *Second.* This terrace is limited by the 115-fathoms line, there being here a well-marked break, before reaching shallow water. *Third.* In passing from the last line to the shore, we meet with a rise about the 35-fathoms line. It is not well defined; but there appears to be rather an abrupt ascent from 45 to 35 fathoms. When these terraces were subaerial, the *first* was probably upwards of 1300 feet above the sea, the *second* nearly 700 feet, and the *third* upwards of 200 feet.

The vertical movements assumed as having taken place in subsequent *epochs* of the Glacial and Post-Glacial periods are in a great measure based on the present premiss.

4th. The first epoch of the Glacial period is generally admitted to have been the coldest. It is my belief that the then British area, with all the land now beneath the German Ocean, also that forming the Irish "two-hundred-fathoms plateau," was shrouded with an enormously thick pall of field- and mountain-glaciers. My views on this subject are in no respect less *ultra* than those advocated by Agassiz and Ramsay. Probably during the earliest portion of the next or subaqueous epoch, the climatic conditions were not much less rigorous: the removal of blocks from low to high levels, in the way suggested by Darwin, requires the coasts to have been thickly girded with ice, like the shores of east Greenland and other Arctic lands at the present day. The close of this epoch appears to have been affected by a somewhat milder climate, which continued into the third (or second subaerial) epoch. If I am right in ascribing, with Agassiz and Lyell, the origin of the Glen Roy terraces to a glacier lake, it may be inferred that the last stage of this epoch enjoyed a still more ameliorated climate; probably ending with a mean temperature more or less resembling that now prevailing in the British Isles.

5th. While I quite agree with Ramsay as regards the powerful degradation which the rock-surfaces of the British area underwent during the Glacial period, I must also contend, from what has already been stated under the first of my premises, that our elevated regions

* Quarterly Journal of the Geological Society, vol. vi. p. 86. I formed the opinion before learning that Mr. Godwin-Austen had advanced a similar one.

:re considerably eroded by glaciers during the close of the Pliocene riod.

Before entering on the next subject, it is necessary for me to men-›n that I wish the greater part of the insertions in the table to be ken in an approximate sense; a few of them, such as "Irish Round ›wers," are offered suggestively.

:marks on the Phenomena of the Glacial and Post-Glacial periods noticed in the Table.

The two periods under immediate consideration are strongly dif-rentiated both by their physical and organic features. It is unne-ssary to add more to what has already been stated on the former. ıe Glacial period was characterized by the presence of species of the :nera *Elephas*, *Rhinoceros*, and *Hippopotamus*, doubtless as amply ›otected against a severe frigid climate as the Bear, Walrus, Musk uffalo, Balene Whale, now inhabiting the ice-bound regions of the rctic Circle. The Post-Glacial period appears to have been always arked by the absence of the genera above named, at least in the :ea of the British Isles. The shells special to the glacial period are ıch as still inhabit the Arctic seas: a few, but very few, may have ecome extinct. Whether any new species have come into existence uring the Post-Glacial period is a question which I am unable to an-wer; but it would appear that a few are special to this term, if we onfine our observations to the British and adjacent seas,—the fol-›wing species, *Lima excavata*, *Haliotis tuberculata*, *Fusus Berniciensis*, nd *Litorina litoralis*, being unrecorded in Glacial and Pliocene de-›osits. The genus *Homo* belongs to both the glacial and post-glacial ›eriod: it was represented as early as the close of the subaqueous poch or the beginning of the second subaerial division of the Glacial ›eriod by a low form or extinct species,—a view strongly countenanced ›y the Neanderthal skeleton, as well as the rudely-chipped flint-imple-nents occurring in the elephant gravels of Amiens, Hoxne, and other ›laces. Probably a higher type existed at the same time, as indicated ›y the skulls found in the Engis caves near Liége. The "Borreby ›eople" of the Post-Glacial period appear to have descended from the Neanderthal race. How far back in geological time it was that the genus made its first appearance on our planet is a question yet to be solved. There is no reason, however, to doubt that it was repre-sented by species during the Pliocene, or even the Miocene period.

The line of demarcation between any two epochs, also between the Glacial and Post-Glacial periods, I assume as being formed by terrestrial and oceanic conditions corresponding to the present re-lative level of land and sea.

Glacial Period.

First (subaerial) epoch.—The elevation of the British area, although the land is assumed to have been thirteen hundred feet (=220 fathoms) higher than it is at present, is not, in my opinion, to be regarded as the cause of the severe climatic conditions of this epoch.

Our present genial temperature, as correctly remarked by Lyell, is exceptional, and it appears to be in some measure due to the Gulf Stream; but, as maintained by Ramsay, some general cause must have operated in producing the extreme frigid climate of the Glacial period, considering that it prevailed over an immensely wide geographical area, irrespective of the area being successively under continental and oceanic conditions, as it was during the first and second epochs. Apparently, the climate was somewhat less rigorous towards the close of the second epoch, and during the one to which I shall next advert.

Second (subaqueous) epoch.—I have considerable doubt that terrestrial, fluviatile, or littoral animal life existed, except very partially, in the British area under the severe conditions of temperature of the first (subaerial) epoch; and I am disposed to apply a similar doubt to the *early* division of the one under consideration. This is the reason why I have excluded fossiliferous deposits from the two stages respectively forming the *close* of the subaerial, and the *beginning* of the subaqueous epoch.

The shells found by Trimmer on Moel Tryfaen (1400 feet in height), and named by Forbes, do not positively indicate an Arctic climate; but this may be accounted for on the supposition that the deposit containing them is of littoral origin. Deposits formed, contemporary with the "Moel Tryfaen Shell Drift," at the bottom of a deep sea, would contain shells of a decidedly Arctic character. At the present time, the littoral zone of the west coast of Ireland is tenanted by southern species (*Diodonta fragilis*, *Avicula Tarentina*, *Circe minima*, etc.); while in the comparatively deep water (100 fathoms) of the plateau, already noticed, there occur the following subarctic species, *Leda pygmæa*, *Limopsis aurita*, *Macandrevia cranium*, etc. The "Airdrie (Lanarkshire) *Tellina calcarea* clay" may be regarded as the equivalent in geological time of the "Moel Tryfaen Shell Drift;" but formed in deep water.

The removal of blocks from low to high levels, in some cases several hundred feet, by the action of shore ice on a gradually subsiding coast may be referred to the first half of the epoch, though I am disposed to think that the same phenomenon, but on a smaller scale, was also produced by land ice during the preceding epoch.

The remarkable broad terraces, deeply cut out of limestone beds (Carboniferous), characterizing the waving slopes of the Clare Hills (1000 feet in height) on the south side of Galway Bay, have evidently been formed, as the land rose out of the sea from a depth of not less than 1000 feet: every terrace indicates a stoppage in the uprising.* It is impossible to conceive that these terraces were formed in the subsiding stage of this epoch, or during any portion of the preceding one: there is also considerable difficulty in the way of sup-

* I noticed these terraces at the Dublin meeting of the British Association, in 1857, in connection with the remarkable jointing associated with them. An abstract of a paper, which contained a further notice of this jointing, is given in the British Association Report of 1857. Professor Jukes has also noticed the terraces and jointing of the Clare Hills in his 'Manual of Geology,' 2nd edit., 1862.

osing that they were produced in the Pliocene period, inasmuch as hey could not have escaped being planed down and obliterated in he first epoch of the Glacial period. The glaciers of this last period, am led to believe, have mainly contributed in giving the Clare Iills, before they became terraced, their leading contours. It does iot appear that the terraces, considering their well-defined edges, vere affected to any extent by the glaciation of the epoch next to be ioticed, except perhaps in the valleys (which run down the slopes), vhere they are only faintly exhibited.*

Some of the freshwater deposits which I have placed in the opening itage of the next epoch may belong to the closing stage of this poch. The land was evidently undergoing minor oscillations at he time, as shown by Prestwich, in his description of the section at Shacklewell Lane, West Hackney, which "affords a clear indication of two gravel periods, separated by an interval of dry land."* I see no reason to doubt that the large earth-crust movements, characterizing the "epochs" of the "Glacial period," were ocasionally accompanied by minor oscillations.

The "Brighton ancient sea-beach" could not have existed earlier than the close of this epoch, otherwise it and its protecting cliff would have been swept off by the powerful glaciation of the previous (subaerial) one.

Third (subaerial) epoch.—The Clare Hill terraces have evidently been more acted on by ordinary atmospheric agencies than by glaciation: it is, therefore, difficult to adopt any other conclusion than that the glaciers of this epoch were smaller than those of the former (subaerial) one. Ramsay has formed the same opinion from other evidences. Still the glaciers of this epoch must have had considerable power to scour the "old marine drift" out of Cwm-llafar, and to deeply erode the rocks of the Brixham, Gower, and Wookey-hole districts. Prestwich has shown that much of the "Biddenham flint-implement gravel" has also been removed by glacial agency. All these phenomena appear to me to be geologically contemporaneous, and, of course, subsequent to the formation of the gravel last noticed. This deposit, however, does not seem to have been formed by the agency of ice, although the one may have indirectly contributed to the formation of the other. A question next arises—What gave rise to the glaciers which scooped out the "Biddenham flint-implement gravel," and effected the other erosions above alluded to? Were they produced by an elevation of the land? or are they to be attributed to some other cause—the land remaining at its old level? Although unable to adduce any positive evidence in favour of either of the views involved in these questions, I am, nevertheless, inclined to adopt the one which admits that the second glaciation arose, in the districts named, and in the British area generally, in consequence of a great but gradual elevatory movement, which stopped when the *second* or 115-fathoms terrace of the Irish submarine plateau became elevated above the sea. Considering, however, the diminished

* Journ. Geol. Soc. vol. xi. p. 110.

		MARINE TYPES.
POST-GLACIAL PERIOD.	Subaqueous. (Land about 25 feet below its present level in middle stage—*b*.)	*c*. Foraminiferous mud (calcareous) now forming in the dept Atlantic.—Deposits forming around British coasts. *b*. Glasgow canoe-sands. *a*. Shell-sands overlying Carnon and Pentuan (Cornwall) taining human remains (Colenso).
	Subaerial. (Land probably 200 feet above its present level in middle stage—*b*.)	*c*. *b*. Dogger-bank *Mya truncata* bottom (King). (The land being at a higher level than it is at present, n deposits could be formed on it.) *a*.
	Subaqueous. (Land probably 300 feet below its present level in middle stage—*b*.)	*c*. *b*. Belfast *Thracia convexa* clays (Hyndman).—Probably su raised beaches as contain only existing British shells, rush (Antrim),—especially of Scotland (Landsborou ford, Jeffreys). *a*.
GLACIAL PERIOD.	Third (Subaerial) epoch. (During the middle stage, *b*, the land possibly reached an elevation of 700 feet or more above its present level.)	*c*. *b*. (Much of the bed of the German Ocean above the sea.- England, and Ireland connected.) *a*. *Astarte arctica* bottom, off Fern Isles, Northumberland (
	Second (Subaqueous) epoch. (During the middle stage, *b*, the land was probably upwards of 2000 feet below its present level.) Erratic blocks (many foreign) transported by icebergs during the entire epoch. Blocks transported from low to high levels. Formation of Clare Hill terraces.	*c*. Pagham (Sussex) "marine gravel" (Godwin-Austen) (near Hull) *Natica clausa* gravel (Phillips, Prestwich) wood Park (Sussex) shell gravel (Prestwich).—Brigh nish, and Devonshire raised beaches.—Howth (Dublin) *Chione* gravel.—Wolverhampton *Astarte arctica* gravel Lancashire erratic-block-shell drift (Gilbertson, M Binney).—Wicklow, Londonderry, and Antrim *Leda obl* (Portlock, Oldham).—Pagham (Sussex) "yellow clay nite blocks" (Godwin-Austen).—Kyles of Bute *Pecten cus* clay (Smith, of Jordan Hill). *b*. Moel-Tryfaen (Caernarvonshire) shell drift,—littoral (J. T —Airdrie (Lanarkshire) *Tellina calcarea* clay,—pelagi *a*.
	First (Subaerial) epoch. (During the middle stage, *b*, the land probably attained an elevation of more than 1300 feet above its present level. No part of the British Isles beneath the sea during the entire epoch.)	*c*. *b*. (The bed of the German Ocean and the Irish Atlantic 200 submarine plateau subaerial.) *a*.
PLIOCENE PERIOD. (Latest portion.)		Bed of German Ocean strewed over with Scandinavian icebe ported blocks, which frequently afterwards, especially in ne became mingled with British field-ice drift; thereby prod mixed unstratified till of north of England.—(See column of Freshwater deposits, Glacial period.)—? Pagham (Sussex) *rugosa* mud deposit (Dixon).—Runton (Norfolk) *Leda my* (J. Trimmer).

LAND AND FRESHWATER TYPES.

marl, and other deposits, now forming in lakes, rivers, etc.

h round towers.—Egyptian pyramids.

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aehenge.
non and Pentuan (Cornwall) silt, containing human remains (Colenso).
igan Scotch fir submarine forest (Yates).
submarine peat bogs. (? Dogger-bank and much of the German Ocean above the sea. Ireid and Spain united: present Asturian flora of S. and W. of Ireland, the remnants of that union.)
Denmark, "Borreby people" living.

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ernan (Co. Dublin) Reindeer deposit (Oldham).
upland forests.
and Isle of Man *Megaceros Hibernicus* marls (Forbes).

. **Menchecourt** (Valley of the Somme) low-level flint-implement gravel (Estuarine).—Mundesly (Norfolk) *Hydrobia marginata* beds (Lyell).—Brentford (Thames) mammaliferous gravel (Morris).—River Air (Yorkshire) Hippopotamus alluvium (Denny).

·. **Last** glaciation of British Isles, during which Caernarvonshire "marine drift" was scoured out—Cwm-llafar, Nant Francon, etc. (Darwin, Ramsay); old unstratified till swept off land surfaces and rearranged (Escars); Brixham (Pengelly), Gower (Falconer), and Wookey-hole (Dawkins) rocks, with ossiferous fissures, eroded; also high-level flint-implement gravels of Biddenham, Amiens, and St. Acheul, in part washed off.—Copford (Essex) "brown clay with boulders" (Brown).

ord (Essex) *Helix incarnata* marl (Brown).—Infilling of Brixham (Devonshire), Gower ·lamorganshire), Wookey-hole (Somersetshire), and other ossiferous fissures.—St. Acheul and niens high-level flint-implement gravels.—Cropthorn (on the Avon) *Cyrena consobrina* alluim (Strickland).—Hoxne (Suffolk) and Biddenham (Bedfordshire) flint-implement gravels. **Grays** (Essex) *Unio littoralis* bed.

ıer contorted drift (Lyell).

subaerial surfaces within the area of British Isles, except highest mountains, (Lyell, fig. 39, 276.)

ıaerial surfaces much decreased; as represented by Lyell, 'Antiquity of Man,' fig. 40, p. 287.)

uswell Hill (near London) drift.

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h unstratified till, formed in preceding stages, eroded and rearranged.—Copford (Essex) grey gravel with boulders" (Brown).

hest and lowest regions enormously glaciated, the resulting débris (unstratified till) often ecoming mixed with the Scandinavian iceberg-transported blocks of the Pliocene period, es·ecially in the area of the German Ocean (not in existence at this time).—Much of the surface·atures of the British Isles formed. Antrim basaltic plateau in many districts deeply eroded; rmation of valleys of the Thames, Severn, Tyne, Tees, etc.

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t mountain-regions of British Isles under glaciation.

r (Norfolk) Norway spruce-forest bed.

size of the glaciers of this epoch, it may be inferred that the land did not attain the altitude it had during the preceding (subaerial) one. Possibly the land, as indicated by the depth of the *second* terrace, never rose more than 700 feet beyond the level it stood at when the "Biddenham flint-implement gravel" was in course of formation, that is, about the present relative level of land and sea. Probably the field-glaciers were wholly, or to a considerable extent, melted in the summer months, thereby giving rise to extensive land-floods. According to this view, the rocks of the then upland plains [enormously abraded in the first (subaerial) epoch] would again be ground down by glacial action in winter;* while in summer, the torrents of water arising from melted ice would sift the glacier débris, piling its blocks, pebbles, and sand into banks (Escars) and mounds, and sweeping the mud into adjacent lakes and seas. This last glaciation would remove or destroy many of the marine deposits formed in the "subaqueous epoch:" hence their scarcity. The Lancashire and Warwickshire shell-deposits have escaped its destructive power.

I quite agree with Prestwich in referring the flint-implement gravels of the Seine and the Somme to two distinct epochs, between which great physico-geographical changes took place.† The oldest (or highest) of these gravels appears to have its counterpart in that occurring near Biddenham. I am not able to correlate any British flint-implement gravels with the youngest (or lowest) occurring at Menchecourt and other French localities; but it is highly probable that some of those recently discovered by Prestwich, Evans, Whitaker, and others are the equivalents in geological time of those forming the lowest series at the mouth of the Somme.

* The flat country lying between Dublin and Galway would, under the conditions named in the text, form an upland plain. From all I can observe, the district around Galway has been covered with subaerial drift (formed during the first glacial epoch) of not less than 300 feet in thickness; I find patches of it lying at a height equal to the number of feet mentioned at Tonabrocken. Much of this drift, in my opinion, has been considerably worn down completely or swept away, at the close of the first and in the middle of the second subaerial epochs. On the worn-down undulating surfaces of this old drift, erratic blocks of granitic rocks, etc., are common: these, I consider, have been transported by, and dropped from, icebergs during the subaqueous epoch of the glacial period. Much information on the subject of Irish drifts and erratics is given by Du Noyer in his highly interesting paper, published in the 'Geologist' of last July. Notwithstanding its original great thickness, the singular fact is common around Galway, that in no case where the limestone has been denuded of the subaerial drift do the wide cracks and joints prevalent in the rock contain a particle of it: one would have imagined the very contrary. I can only account for its absence on the view, advanced in the text, that the limestone, on which the drift was originally deposited, has, in addition to the degradation which it underwent towards the close of the first (subaerial) epoch, been much abraded by the winter glaciation of the third (subaerial) one; thereby exposing beds which were not uppermost when the drift was in course of deposition.

† Apparently Mr. Prestwich does not go so far in the views stated as I do. All the evidences bearing on the physico-geographical changes noticed in the text show that the intervening time, between the epochs to which the two series of flint-implement gravels are referred, was of enormous length. The Rev. Mr. Symonds correctly observes that the physical geology of the oldest or highest of the Somme valley gravels "proves their immense antiquity even more than do their fossil remains." (Geology of the Railway, p. 14.)

The formation of the gravel terraces of Glen Roy appears to have taken place in the last half of this epoch—when the land was subsiding. Had they existed previously, they must have been obliterated by glaciation. Nothing affords a better explanation of their origin than the view originally advanced by Agassiz, and lately adopted by Lyell, that they were formed in a valley converted into a lake by the damming up of its mouth with a glacier which descended from Ben Nevis. Admitting that the Glen Roy terraces have been formed in this way, it must be conceded that the land was at the time gradually yet intermittently subsiding. While the subsidence was going on, it may be safely assumed that the glacier-dam became more and more reduced in height, causing at the same time the level of the lake. water to fall lower and lower, until, finally, both glacier and lake disappeared altogether. Possibly the melting of the glacier was facilitated by the gradual setting in of the more genial climatic conditions which prevailed in the succeeding epoch. It is unnecessary to suppose that the land, when subsiding, descended beneath its present level in the last stages of the lake and glacier.

The way in which the glacier-lake of the Märjelen-see is formed and sustained, that is, by the glacier of Aletsch, as described by Ramsay, may be accepted as a good illustration, on a small scale, of the origin of the old glacier-lake of Glen Roy.

Post-Glacial Period.

First epoch (subaqueous).—There are several mountain bogs in the west of Ireland containing the remains of rooted trees which could not, under present conditions of temperature, grow at their present elevation. I am strongly inclined to believe that they grew at a lower level. The "Belfast *Thracia convexa* clay" may have been deposited about the same time in deepish water.

Second epoch (subaerial).—During this epoch, considerable portions of the submarine area between the south of Ireland and the coast of Spain, and averaging about 200 feet in depth, was elevated above the level of the sea, giving rise to a land-surface which botanically connected these two countries. The connection, although now physically severed, is still maintained, as Forbes noticed in 1816, by the presence of Asturian plants—*Dabeocia polifolia*, *Pinguicula grandiflora*, *Arabis ciliata*, *Trichomanes radicans*, etc.—in Kerry and Connemara. Forbes conceived that the "destruction of the intermediate land took place before the Glacial period;"* but since he wrote, the researches of Ramsay, Prestwich, Lyell, Trimmer, Godwin-Austen, Jamieson, Falconer, Pengelly, Chambers, and numerous others, in Post-Pliocene geology, render it highly probable that the "destruction" occurred at a much later period; in short, that Ireland, England, and Spain were united during the earliest age of tin-mining in Cornwall.

In numerous places on the Irish coast there occur extensive submarine peat-bogs, which, it is evident, cannot have been formed when the forests last noticed were growing as supposed, or at the present

* Mem. Geol. Survey, vol. i. p. 348.

relative level of land and sea. They must have been formed whe the land was higher than it is at present,—perhaps not more tha 200 feet. These submarine peat-bogs may have been formed conten poraneously with the shell-deposit next noticed.

Some years ago, when dredging on the west side of the Dogg Bank, off the coast of Durham, in about 50 fathoms water, the dred brought up a large quantity of dead specimens, in a chalky conditio of *Mya truncata* (Annals Nat. Hist. vol. xviii. p. 233). It is impos ble to conceive that these specimens of a littoral species lived at t depth from which they were procured; nor can I admit that th have been transported from a shallower habitat by marine curren There is less difficulty in contending that they lived on the sp which yielded them, when the Dogger Bank was a subaerial surfac and that the species ceased to live in the locality when the land l came submerged.

Third epoch.—Influenced by the investigations of Geikie, also some considerations given in a notice which I have elsewhere pu lished ('Parthenon,' No. 50, April 11, p. 417), I am led to belie that the "Glasgow canoe-sands" are not so ancient as some archæol gists have conceived. Possibly some portion of this deposit may of high prehistoric antiquity; but evidently some of it was form when Scotland was occupied by the Romans.

Admitting the view just stated to be correct, it necessarily follo that the geological epoch under consideration includes the historic era of our country. A question now suggests itself—Are the sligl vertical movements of the Post-Glacial period equal in chronologic value to the much larger ones of the Glacial period? Or another- Are they simply equivalents of the minor oscillations which accon panied the great movements of the latter term? Considering th magnitude of the physico-geographical changes which characterize the Glacial period, as compared with those of the following one, feel most inclined to adopt the view comprehended in the last que tion. In this case it may be contended that the Post-Glacial peric has not yet advanced beyond its initial stages.

SPECULATIONS ON POSSIBLE PHYSICAL AND CO MICAL PHENOMENA IN REFERENCE TO THE PAS CONDITIONS OF OUR EARTH.

By S. J. Mackie, F.G.S.

Whenever we begin to think about the formation of the unive we get at once into the realms of speculation, and the only value our thoughts rests in their probability. In everything unknown must first form an idea—that is, speculate; then, by partial gath ings of facts, or by positive reasoning, we may theorize. Ultimat by the accumulation of evidence, we may prove that which, in first place, we only imagined. When first men observed the sun, they regarded the earth as a flat plain, over which the sun passed in his heavenly course, and below which, at eve, he retired to rest. It was not until many ages had elapsed that the world came to be regarded as round, and even then it was long before the sun was considered as a fixed centre of the planetary system revolving round him.

By no nation of ancient times has astronomy been more advanced than the Greeks. Not that the Greeks ever *worked out* much to a proved result, but they were an imaginative people, and they invented notions. If one theory or speculation was disproved, they invented another; and, hit or miss, they always seemed to have fresh ideas in reserve. In some things astronomical, as in many other things that the world believes in, we may be heretics, and we admit we do not adhere to all the cosmical, physical, geological, and spiritual tenets of the popular faiths. We may not entirely believe in the perfect stability of the universe; we may doubt the eternal endurance of the sun's bright rays; and we may not quite acquiesce in the unchangeable permanence of tne planetary orbits: in short, we do not believe in the *permanence* of anything whatever in creation. All ever ***has been*** change, and changeful all things ever ***will be***. Diversity and change are visible in the first created things of which any relics have been left us. Diversity and change are palpable in every living creature and every inanimate thing around. The foreshadowings of future changes fall everywhere and on everything. Never, in all the Great Past, do we find a ledge of stability on which to rest the mind's weary flight; nor in all the future can we spy one solitary changeless rock on which to seek repose. The mind, like the fabled flight of the gorgeous birds of paradise, is doomed to endless effort,—from birth to death to be ceaselessly on the wing. It is a fashion, however,—and has been more so than it is now,—to talk about the stability of the universe. Nothing is, ever was, or ever will be, *fixed* in space. Not even the "fixed" stars, for we know they are all *in motion*; and the spectral analysis of the light of some, at any rate, shows that those whose rays we can analyse are in a state of combustion—burning like our own sun. Notwithstanding the sublime edict for the creation of light in that Bible most people profess to believe, we suspect strongly that most people regard the light of our sun as eternal. If eternal in the future, why not eternal in the Past? If not eternal in the past, why eternal in the Future? Not that we think such arguments always bear.

The mind naturally clings to the idea that creation began; and the more educated, the more competent, the more reflective the mind becomes, the more it clings to the conviction that creation *did* begin. But having begun, having progressed, still progressing, who will dare to think it shall ever cease? Such a thought involves the extinction, death of the Creator. Never! More glorious and more powerful day by day, and age by age, the Almighty Strength may grow and increase, but diminish, cease,—never! But, back to our point. Has the sun shone for ever in the backward Past? Certainly not! Will it light up for ever in the endless future the vast and glorious space its beams illumine now? Perhaps not. The sun may go out—it may be millions of years to come ere it does, but its light may some day be darkened. It is a long time to look forward to when *that* will happen, we admit, and the race of man may pass away like the many life-races of the Past, long before the bright rays of that "glorious orb" begin to fade. But change is everywhere; we see it in everything around us; we read the record of change everywhere and on everything in the Past. The first land, so far as we can make out, differed from our dry land now; the first plants differed from those that clothe the dry land now; the first living creatures differed from the animated beings around us. Fish, flesh, nor fowl put on the same bodies; perhaps even air and ocean differ. How, then, were the planets weighed to a grain and forbidden to increase? Were their distances measured off to a millimetre, and the irrevocable order passed, "Nearer shalt thou not approach, further shalt thou not recede from the burning sun"? For the sun was the edict passed, "Without increase or waste, burning shalt thou go on for ever and ever"? Such an edict would make the sun an eternal *creator* of force. And no one believes in *creation* except from God. Who but He, in the incomprehensible beginning of all things, created the first atom of force, and has gone on unceasingly multiplying force upon force ever since?

It is well even in this world now and then to go out of the beaten paths and to explore new lands—if even the result be only to convince us of the value of the old ones. It is well, too, in science now and then to diverge on to the realms of speculation—if even only to attain a conviction of the accuracy of that which has been accepted. At one time we had too much of speculation and too little of facts, but in the advancing sciences of late, perhaps we have had too many facts and too few speculations. Bricklayers would make of bricks but a poor edifice if the architect had not imagined the building beforehand. We all know how Physical Geology, as a science, is looked at in the ordinary way; and no one who looks closely at the picture presented for our acceptance as the portraiture of what was, what has been, and what has happened, but must think that the picture offered has many flaws. The artists claim pre-Raphaelite minuteness and correctness in its execution; they profess to have studied facts, and to have built their picture up scene by scene, leaf by leaf, texture for texture. We do not condemn *their* pre-Raphaelite painting; but we claim the artist's right to let *our* fancy loose, and to sketch out imaginary pictures of our own.

Let those who have gone before us claim veracity for their depictions, we ask only that ours may be looked upon as fanciful scenes; but if in our visionary sketchings the tracery of truthful expression be detected, do us then the justice to let *that* be treasured and preserved. Our task is not to upset an old school and found a new, but to seek out Truth.

For this purpose, then, we commence in this article a series of speculations on possible physical and cosmical phenomena in reference to the past conditions of our Earth, not always with the intention of proposing new views or even our own opinions, but as often putting hypothetical cases to learn what would have been the results produced by particular conditions of physical forces and the exertion in particular directions of cosmical laws.

At this lovely spring-time of the year, the bright warm beams of the shining sun cause our eyes to rise to the blue and cloud-mottled sky. All around, the green buds are shooting forth, and flowers blossoming and perfuming the balmy air. What would this beautiful world be without that sunshine? What would indefatigable, active man be without these cheering, life-exciting beams of the orb of day? The sun is but a great fire; fire, we know, consumes the substances it feeds upon; gigantic as the solar orb may be, the fire must burn it out, and, like the dark stars that astronomers now have indicated, the time may come when the earth, changed, perhaps, itself to a burning mass, may reveal by its luminous beams to the astronomers of distant worlds its revolutions round an unseen, dark, extinguished sun. But without so deep a dive into the mysteries of time to come, let us ask ourselves what would be the effect of minor alterations in the solar fire? We cannot believe the solar flames are always burning at exactly the same height, with exactly the same fierceness, giving exactly the same heat, exactly the same light. The fire on our hearth flickers, blazes, grows dull, requires fresh fuel, smoulders, bursts into flame again, burns clear and ruddy, glows with radiant heat, darkens, chinkles, and goes out. The consumption of the solar fire must be supplied; we cannot believe that as particle by particle is consumed, particle by particle is supplied. Even if meteors supply the sun, they must vary in abundance at different periods of time. If worlds fall in occasionally to supply the waste, the solar fires at that spot must slacken, deaden, to glow out again bright and more furiously when the new fuel is ignited through. For geological purposes, without going into *great* variations of the solar fire, let us conceive two modifications,—one of 15° increase of temperature from such a cause, and one of 15° decrease. We are told the centre of the earth is a burning incandescent fluid mass,—rather an uncomfortable idea, and not quite intelligible. We are taught it, however, mainly because the fossil relics of former creatures and plants are *supposed* to indicate tropical conditions in latitudes where now temperate conditions prevail. Unfortunately, however, in digging down into the bowels of the earth we do not find the temperature increase more and more with the depth, the heat increase faster and faster as we get nearer and nearer to this imaginary central melting-pot; we do not, in short, find the heat of the handle increase more rapidly as we pass from the knob to the red-hot end of the poker. Just as Glaisher going up in the high regions of the air has disproved the old doctrine of a supposed decrease of one degree of heat for every 300 feet of vertical height, and found a gradually diminishing scale of loss, 1°

for the first 100, and so on until above three miles and a half it takes a thousand feet to lose the required degree of heat,—so geologists, instead of getting even a regular correspondence of 1° Fahr. loss for every 63 feet of depth, find a gradual divergence in the ratio of vertical depth to loss of heat, and at one mile down have to go more feet to get it. And let it not be forgotten that these results have been given us by men who are pledged to the opposite view, who would rather not have known these truths, and perhaps would have hid them if they could. It is possible, then, that other causes than internal heat may have caused a former higher temperature of the globe. But more of this anon. Suppose now the other case—that the average temperature of the whole earth was 15° less than it is now. What would be the result? Glaciers in Wales and Scotland again as once there were before; ice-floes in the valley of the Thames and on the Norfolk shores driving up the beds of sand and mud into contorted strata, such as we have in the Mundesley cliffs; and icebergs dropping—if the ocean-currents flowed on as once they did—boulders of Scandinavian and other foreign rocks on the midland counties and the northern regions covered by the Glacial drift.

Miller has shown the heat of the sun to be not more than 14,580° Fahr.,—the heat of the oxy-hydrogen flame,—and probably it is not much less. Now the surface of the sun is given as 12,500 greater than the earth's, and, therefore, taking the earth's surface as unity, we have the proportion of 12,500 to 1.* If, therefore, assuming for convenience the temperature of the sun as 12,500° (instead of 14,580° Fahr.), we suppose our earth to fall into the sun, without igniting on its external side, the total amount of heat radiated from his surface would evidently be 12,499°, or reduced by the size of the earth by one unit of heat, giving the surface the equivalent of one degree of heat.

But as the sun presents only one side to us, a loss of radiation of heat to the extent of two degrees would take place on the side of the sun to which the non-radiant earth was attached. As the sun however rotates on its axis in 25 days, every alternate fortnight or thereabouts the total temperature of the solar rays would be 2° Fahr. less

* Considerable confusion of ideas and a want of logic will be attributed to me in these articles if it be not distinctly borne in mind that I adopt popular ideas and popular phraseology *only for the moment*, and that it is *not intended* to work these speculations into any *definite theory*. If any definite conclusions be arrived at, they will be given as *corollaries* to these speculations, and not embodied in them. For example, we speak now upon the dictum that the volume of the sun is 1,400,000 greater than the earth, its mass being as 354,936 to 1, and its diameter as 882,000 to 8000, or 111½ times greater than the earth. This gives the sun a mean density four times less than the earth,—a point we shall presently discuss, as it is very questionable if we ought to take the visible face of the sun, and his apparent size, in determining his density, because heated to the extent of nearly 15,000 degrees, and having, as astronomers declare, an exterior luminous photosphere; and, as Kirchhof and Bunsen have shown, a still exterior atmosphere of luminous incandescent metallic vapour. The light-exhausted internal nucleus of burnt-out and probably solid material of the central core of our luminary is what we ought to consider as the actual globe of the sun, and which is what we should properly estimate for his mass and density, at any rate for purposes of comparison with our earth.

than in the intervening periods. Now Tyndall speaks of the earth receiving but the $\frac{1}{2300000000}$ part of the solar rays, and therefore it might be said that the falling in of the earth would only reduce the temperature of the earth by that part of a degree; but, on the other hand, we should have to consider what influence such an event would produce if the point of collision and obscuration was in a direct line with the earth. In such a case the direct light- and heat-rays would be shut off, and although compensated for in a great degree by the convergence of the surrounding rays in the great flood of light coming away from the sun, a considerable effect might be produced on the temperature of the earth. Of what effect might be produced we have perhaps some examples in the actual effects produced by sun-spots. Single spots often appear of dimensions equal to and exceeding that of our earth, and periodically we have numerous congeries of spots of sufficient importance to produce disturbances at any rate of the magnetical conditions of our globe if not indeed to produce any distinctly perceptible diminution of temperature. That the latter effect might not be readily determinable in the converging or fluctuating states by our atmosphere is by no means surprising; but it should be borne in mind that Arago and other astronomers have asserted and attempted to prove that the maximum periods of sun-spots are regular decades of colder years. Such minute changes as those produced by these minor differences in the amount of materials in actual conflagration would have had little effect on the general climatal temperature of our earth, but if a difference, no matter how small, could in this or any other way be proved, it would be a basis for real conclusions on the subject. There are, however, five other ways in which the solar rays might affect the general climatal conditions of the earth. 1. The mass of the sun being larger or smaller would radiate more or less heat accordingly. 2. There might be maximum and minimum periods of conflagration. 3. The extent of the earth's atmosphere might influence climatal condition by the conversion by friction of the light rays into heat, just as light rays falling on a black surface are arrested, annihilated, converted into heat, which they are, and on the same principle that a falling bullet striking the ground has its velocity or motion changed into an equivalent of heat. 4. A former higher and lower rate of rotation of our own globe would have important effects upon the climatal conditions and on the vegetation and life of our planet. 5. Variations in the dimensions of the orbit of the earth.

(*To be continued.*)

ON CHELONIAN SCUTES FROM THE STONESFIELD SLATE.

By C. Carter Blake, Esq.

In the British Museum there are several specimens of "papilionaceous" flattened bodies exhibiting six or more concentric lines radiating from two nuclei on either side of an elevated medial line. The stone in which they are embedded is unquestionably the Stonesfield slate; it contains the characteristic *Trigonia angulata*, *Rhynchonella*, *Ostrea*, and *Modiola Sowerbyana*, D'Orb. (= *plicata*, Sowerby). The enigmatical bodies to which I now allude are stained of a deep red-ferruginous colour, the matrix retaining the grey tint and crystalline texture of the Stonesfield slate. On comparison between these remains and those of the specimens of *Geomyda spinosa*, from Singapore, in the British Museum, presented by Sir A. Smith, a comparison which was suggested to me by Mr. Davies, whose accurate discrimination first threw light upon the nature of the present evidence, I have been led to consider that the specimens in the Fossil Gallery represent the second, third, and fourth median scutes of a tortoise allied to the recent African species. The fossils and their corresponding impressions from the Stonesfield slate afford, according to my interpretation, evidence of the texture of the horny scutes which were developed outside the bony carapace of the old Oolitic tortoise. A particular interest is attached to these specimens, as they were considered by the late Edward Forbes as Trigonellites, or opercula of Ammonites.

Since the above was written, I learn that Dr. J. E. Gray, several years ago, considered the present evidences to be Chelonian. I am indebted to my friend Mr. S. P. Woodward, F.G.S., for this information, and am now aware that the true signification and interpretation of these remains has been known to him for a long period.

CORRESPONDENCE.

Holoptychius v. *Glyptolepis*.

DEAR SIR,—My notice of the Dura Den Glyptolepis, in your number for March last, was merely intended to correct an impression which Mr. Mitchell's paper in your February number seemed calculated to convey, namely, that it was he who first pointed out the propriety of transferring *Holoptychius Flemingi* from the genus Holoptychius to Glyptolepis. In doing so I seem to have expressed myself so loosely as to make it appear that I claimed for myself and others the merit of first noticing the crescent of points on the scales of that fish. This I by no means intended to do, as I was well aware that these had been long before observed; indeed a glance at the figure given by Agassiz in his 'Vieux Grès Rouge,' pl. 22, fig. 1, will show that this peculiarity had not been overlooked by him. I was also aware that Professor Pander had expressed his belief that the scales of *Holoptychius Flemingi* and *Glyptolepis leptopterus* were the same; these I consider specifically distinct. But lest I might seem to claim too much, I forwarded to you a note to be added to my letter, which seems to have arrived too late for insertion, and which, by some strange mistake, has been printed in your number for this month (April) as the first paragraph of a communication from the Rev. W. S. Symonds. I may add that Mr. Page, of Edinburgh, was the first to point out, in my hearing, the existence of Glyptolepis scales in the Dura Den Sandstones.

Mr. Davies, in his communication in your April number, refers to the greater imbrication of the scales "mentioned by Mr. Mitchell" (no new discovery), and also to the general character of the ridges on the scales, as being differently and distinctly marked in the two genera. Undoubtedly, retaining the old nomenclature, the scales in *H. giganteus*, *H. nobilissimus*, etc., are less imbricated, and have the ridges more wavy and boldly marked than in *H. Flemingi*, but on examining a large collection of the Dura Den fishes, a pretty regular gradation from the less to the more imbricated and from the bold wavy ridges of the larger species to the almost parallel and delicately marked lines found on the scales of some of the others, may be traced. Mr. Davies's remark as to the position of the scales showing the crescent of points scarcely corresponds with my experience, but this may very probably be occasioned by our observations being principally confined to different species. In *H. Flemingi* many scales on every part of the body sufficiently preserved and exposed, which I have yet examined, show the crescent of points, while in other species these are only to be found on the scales along the flanks.

I am very glad to learn from Mr. Davies that the characteristic specimen of *Holoptychius Andersoni* in the British Museum shows, what I have been unable to detect in that species, the crescent of points,—as this is a considerable step towards clearing up the dispute Holoptychius *v.* Glyptolepis. Professor Huxley states in his introductory Essay to the X Decade of Plates published in connection with the Geological Survey (p. 9), "The clear recognition of the fact that this elegant structure really characterizes Glyptolepis is of great importance, for . . . it enables one to discriminate between Holoptychius (*whose scales have no semilunar area of backwardly-directed points*) and Glyptolepis."

I have to express my gratification at the notice Mr. Davies takes of these communications; to local geologists situated at a long distance from collections affording facilities for comparing the many species of such genera, and ever comparing nearly allied genera with one another, such hints as he gives are very valuable indeed. I am, dear Sir, yours truly,

JAMES POWRIE.

Reswallie, April 10th, 1863.

Bones at Macclesfield.

DEAR SIR,—You obligingly inserted a paper from me in Vol. IV. of the 'Geologist,' and the following communication may perhaps interest some of your readers:—

A few days ago, in levelling a piece of ground as a site for an infirmary, a few bones and a molar tooth were discovered by the workmen. Thirty feet below, there is a small brook, which runs into the river, distant about a quarter of a mile, at a further decline of about 70 feet. The bones were embedded a little apart from each other, in a layer of fine sand about 18 inches in thickness; above that there was a deposit, about 2 yards in depth, of coarse sand and gravel, thickly studded with large waterworn pebbles of the Primary, with a few of the Secondary sandstone rocks. About 18 inches of soil (alluvium) surmounted the whole. The excavation was continued about 2 yards below the bed of sand in which the bones were found, and it consisted of thin layers of gravel with marl and fine sand at irregular intervals, interspersed with carbonaceous markings and thin seams of drifted coal or shale. I have resided here many years, and the osseous remains I have sent for your inspection are the first I have seen or heard of; and, with the object of affording assistance to a solution of this discovery, perhaps I may be allowed to state a few particulars respecting the geological character, etc., of this district.

The surface immediately around Macclesfield is covered by the drift deposits, except in the valleys, where the river and its tributaries have, more or less, cut through them; and the prevailing feature of this locality, except on the eastern side of the town, is of an undulating character, consisting of mounds, inclined planes, and rounded ridges, composed chiefly of stratified sand and gravel, with an elevation occasionally of about 300 feet. The boulder clay, or till, which underlies the whole and reposes upon a lower gravel, often forms the beds of the river and smaller streams. This clay is unequally distributed in some places with respect to regularity, thickness, and extent; sometimes it approaches the surface with a depth of 60 or 70 feet, and it contains fragments of drifted coal, pieces of wood, and small boulders belonging to the Azoic and Palæozoic periods. Occasionally for yards not the smallest pebble is to be found in it. It is of a solid and tenacious quality; colour, dark-brown or slaty. The upper portion is of a more sandy nature and is made into bricks, the lower part is made into tiles, tubing, etc. Superficial patches of peat containing trunks of trees are prevalent. About a mile southward of the town, there is a large peat-bog 20 or 30 feet in depth. Here and there in the fields are to be seen erratic boulders of every size and variety. One weighing above 20 tons and of a sagenitic character was transferred to the public park a few years ago. The brick-clay had been its bed, and it was only about half covered with drifted sand and gravel.

The southern termination of the Cheshire coal-field extends to about two miles eastward of the town; and beyond that point, for about four or five miles towards Buxton, there is a large tract of high and barren moorland of the millstone grit formation. This district comprehends what is called the "Macclesfield Forest," its highest point (Shutlinglow) being above 1700 feet above the sea-level. From historic records, centuries ago this was royal hunting-ground, and abounded in wild boars, deer, badgers, otters, etc. The discovery of these bones may possibly lead to another fact, viz. that at an epoch far more remote,—the close of the Pliocene period,—the climatal conditions of this part of the island were even then favourable to the existence of at least some of the above animals, until the advent of the Pleistocene era, when the glacial drift, with its submerging effects and conflicting tides and currents, swept away their remains with other looser deposits from the higher grounds into the levels below. The otter still survives, but the last badger seen in this neighbourhood was killed about twenty years ago. It is rather surprising that the reliquiæ of the Tertiary fauna are not oftener met with, together with human relics, viz. bones, implements of war, husbandry, and the chase, especially in the gravels of these valleys.

At 70 yards deep, the coal-measures (superficially flanked by the boulder clay) are worked within half a mile of the town. They then take a northwesterly dip, both under it and the river, at a very acute angle, and are no longer available, being overlaid by the drift and probably the Lower New Red Sandstone. This remains to be investigated, and I believe there is a fair prospect of its being done this summer by officers of the Geological Survey.

Perhaps there are few parts of this kingdom which are attended with a greater variety and complexity of strata, with their apparent dislocations and disturbances, than this corner of Cheshire. Within a distance of 8 or 10 miles south and east, there are encompassed no less than seven or eight distinct geological divisions; viz. drift, Cheshire coal-field, millstone rit, mountain limestone (Derbyshire), North Stafford coal-fields with illstone grit, mountain limestone near Congleton, and the Permian and riassic systems of Cheshire and Staffordshire. This survey has been ong looked forward to, and will be hailed with pleasure and satisfaction hen published. I am, dear Sir, yours respectfully,

J. D. SAINTER.

Macclesfield, April 8th, 1863.

[The bones referred to as from the gravel, which have been sent to us for examination, re, 1, metacarpal of ruminant (*Bos longifrons*); 2, calcaneum of ditto; 3, fragment of ammalian bone; 4, upper molar of ruminant (*Bos* of small size); 5, base of shed ntler of red deer (*Cervus Elaphus*). This last specimen, which is but a mere fragment, eems to have the remains of a hole that had been drilled or worked in it previous to its mbedment, possibly for the insertion of a celt or other instrument to which this deer's orn served as a handle. All the bones are in a porous condition, and not in any way etrified.—ED. GEOL.]

Glyptolepis.—Upper Ludlow Fossils.

MY DEAR SIR,—I beg to call your attention to an error in the last number of the 'Geologist,' at page 134. I know nothing of the claims of Mr. T. Walker as having made known the fact that *Holoptychius Flemingi* is in reality a *Glyptolepis*.* My communication to you referred simply to the detection of Keuper fossils at Ripple, near Tewkesbury.

It may be useful to some collectors if you will make it known, in a future number of the 'Geologist,' that Samuel Sturge, shoemaker, of Ledbury, has discovered a highly fossiliferous band of the Upper Ludlow bone-bed, within a few miles of Ledbury. This bed is remarkably rich in spines of fish (Onchus), and the earliest known traces of terrestrial vegetation, which are small seeds of a plant allied to the Lycopodiaceæ.

Yours very truly,

W. S. SYMONDS.

Pendock Rectory, Tewkesbury, April 4th, 1863.

Human Remains in Brick-Earth at Luton, Kent.

SIR,—I have the pleasure to inform you that a few weeks ago two skeletons were found in a brick-field near here. The soil is brick-earth, the top part for about 4 feet mingled with flint, below that the pure clay. The skeletons were found between 6 and 7 feet from the surface, one lying on the back, the other on the side, with their heads towards the north; near them was found a triangular stone weapon, rudely formed to be wielded with the two hands, its weight is 14 lbs. The skulls exhibit a very debased form, the foreheads very low and receding, the back part very large; in one the bone of the nose turns up in a very peculiar manner They are evidently of great antiquity, and have been undisturbed for very many years, for above them were the decayed roots of very large trees. The site was a large forest and hunting-ground in the reign of Elizabeth, who had a hunting-lodge in the neighbourhood, remains of which are still in existence. The skeletons were exhibited at a meeting of the Anthropological Society, held on April 7th; and the stone implement will be shown at their next meeting on the 21st. I remain, yours sincerely,

N. F. RIVERS.

Sidney Villa, Luton, Chatham, April 16th, 1863.

* The passage referred to was, by a singular error of the printer, inserted in Mr. Symonds's letter instead of in "Notes and Queries." It was a note sent by Mr. James Powrie, of Reswallie.—ED. GEOL.

FOREIGN INTELLIGENCE.

Human remains have been reported at last from the flint-implement-bearing gravel of Abbeville. M. Boucher de Perthes announced to the Société Impériale d'Emulation of Abbeville, of which he is President, on the 16th ult., that on the 28th March last he had found in the bed of argillaceous black sand in the bank of diluvium at Moulin-Quignon, and extracted himself from the deposit, the moiety of a fossil human jaw, which at the first glance seemed to him to present some difference from the ordinary human jaw. "This jaw," so runs the extract from the *procès-verbal* of the meeting of that Society, printed in the local newspaper 'L'Abbevillois' of the 18th April, "was at 4·52 metres depth, and almost touching the chalk. At a few centimetres distance, equally embedded in the 'black bed,' was a flint-implement (*hache*), which M. de Perthes requested M. Oswald Dimpré, who accompanied him, to take out, but he could not do so without the aid of a pickaxe; M. Dimpré, sen., and five other persons were present at M. Boucher de Perthes' discovery, and saw him extract the jaw from the diluvial bed. Examined by Drs. Jules Dubois and Hecquet, and by M. de Villepoix, pharmacien,—all three members of the Société d'Emulation,—this jaw was recognized as fossil and very evidently belonging to a man, offering at the same time, as M. de Perthes remarked, some differences from the conformation of ordinary man. Since the discovery, the Abbé Bourgeois, Professor of Philosophy and Natural History at the College of Pont-le-Voie, came to Abbeville on the 10th April; Dr. Carpenter, Vice-President of the Royal Society of London, Dr. Felix Garrigou, Member of the Geological Society of France, Dr. Falconer, Member of the Royal Society of England and Geological Society of London, arrived on the 14th; M. de Quatrefages, Member of the Institute, Professor of Anthropology at the Museum of Natural History at Paris, arrived on the 15th, and have unanimously confirmed the opinion of the above members of the Society of Emulation, and declared that the jaw is fossil and truly that of a man, but that it presents some differences with the present race, as was remarked by Messrs. Jules Dubois and Hecquet, when they were consulted on that point by M. Boucher de Perthes. M. Catel, surgeon-dentist, made the same statement."

On the 11th, the diluvial deposit of Moulin-Quignon was visited by the Abbé Bourgeois, and on the 13th, 14th, and 15th by Messrs. Carpenter, Garrigou, Falconer, and Quatrefages, who, after verifying the bed and the place whence M. Boucher de Perthes had extracted the fossil jaw, have admitted that the bed is ancient and not disturbed (*remanié*), and the fossil origin of the jaw presents no matter of doubt. On the 14th, Dr. Falconer and Dr. Garrigou caused an excavation to be made in the same bed, in search of new bones. Dr. Falconer found and extracted himself, from the bed of black sand, not far from the place where M. de Perthes had found the jaw, and at 4·55 metres in depth, a flint *hache* neatly manufactured. M. Brunet, member of the Société d'Emulation, who had come to inspect the bed, witnessed this extraction. On the 15th, M. de Quatrefages having wished also to excavate this bed, had the like success as Dr. Falconer, and, pick in hand, brought out two *haches* reposing on the chalk at nearly five metres depth. Dr. Falconer and M. de Perthes were present.

M. de Perthes discovered, the same day, in the stratum of yellow sand in the same deposit, at $3\frac{1}{2}$ metres from the surface, two fragments of bone that Messrs. Falconer and Quatrefages immediately recognized as fragments of mammoth tooth (*Elephas primigenius*). M. Boucher de Perthes lds, that in a mass of bones that had been found at Menchecourt, where ley were found in the early part of April, at 8 metres depth, in the sand uarry (*sablière*) of M. Dufour, he had noticed a fragment of human jaw nd six teeth that Dr. Falconer declared, pending the more ample examination he will give them, fossil teeth, and certainly human, but belonging a race more allied to our own than the jaw from Moulin-Quignon. M. e Quatrefages was present.

M. Boucher de Perthes stated that he would, at a future date, communicate to the Société d'Emulation a circumstantial account of his double iscovery.

For the Secretary, E. DELIGNIÈRES,
Abbeville, April 18th, 1863. *Vice-Secretary.*

To this account the writer in the 'Abbevillois' adds: "We learn that I. Buteaux, *ancien membre* of the General Council of the Somme and iember of the Société d'Emulation, known by his fine geological works, ame yesterday morning to Moulin-Quignon, and having made an excaation took himself from the diluvial bed of black sand a flint-implement *hache*), and which was at about 5 metres in depth, near the chalk, and in ae seam where M. de Perthes discovered the human fossil. M. E. Delignières assisted at this digging, as also Mr. Nicholas Brady, of London, ho also extracted with his own hand a manufactured flint. M. Boucher e Perthes, in his book on diluvial antiquities, said, in 1847, that some day hese antediluvian hatchets, then so rare, and the reality of which some eople did not believe, would be found everywhere. This prediction is erified. He added, that it would be the same with human fossils. We re now brought to believe that in this respect also Mr. de Perthes has rightly predicted. But what has struck us above all is that he equally announced that when they did find this fossil man he would exhibit, like other antediluvian mammifers, some difference of conformation from recent individuals. The form of the jaw of the fossil man of Moulin-Quignon shows that here also he was right."

Since the publication of this account, Messrs. Prestwich and Evans have visited Abbeville, and in conversation, on their return, expressed themselves convinced that the quarrymen of Abbeville have committed an ingenious fraud, and that the flint-implements are of recent chipping, and the human bones not fossil. Later still, Dr. Falconer has published the following letter in the 'Times:'—

The Reputed Fossil Man of Abbeville.

TO THE EDITOR OF THE TIMES.

"SIR,—The asserted discovery of a fossil human jaw at Abbeville has already been noticed in the 'Times;' it has been the subject of a communication to the Royal Society, and at the present moment it is exciting the most lively interest in the scientific circles of both England and France. Having passed a couple of days at Abbeville with M. Boucher de Perthes closely examining all the circumstances of the case, and having been entrusted by him with some of the specimens, which I have now by me here, I am in a position to throw some light on the subject. The case, as a whole, presents one of the most subtle instances of perplexed evidence on a point of science that has come under my experience, and is well worthy of a hearing, from the lesson of caution which it inculcates.

"Fashioned flint-weapons, unquestionably of very remote antiquity, and as certain proofs of human agency as the watch in the illustration of Paley, have turned up in surprising abundance in the old gravel-beds of Amiens and Abbeville, but hitherto not a vestige of the bones of the men who shaped them into form. Why it should be so has remained a mystery, for human bones are as enduring as those of deer, horse, sheep, or oxen, and fossil bones of extinct animals are not unfrequent in the Somme Valley deposits. At last it was thought that the objects so long sought for in vain had been discovered. To pass over minor incidents, on the 28th of March M. de Perthes was summoned to the gravel-pit of Moulin-Quignon (described by Mr. Prestwich in his memoir in the Philosophical Transactions) to examine, *in situ*, what appeared to be a portion of bone projecting from the cliff of the section, close to its base. ('L'Abbevillois,' Avril 9.) The specimen was carefully detached with his own hands by M. de Perthes, and proved to be the entire half of an adult human lower jaw, quite perfect, and containing one back tooth,—namely, the penultimate, or last but one. The sockets of the other teeth were all present, and filled with matrix, with the exception of the antepenultimate, the socket of which was effaced, the tooth having been lost during life. The solitary molar present was hollow from caries, and crammed with matrix.

"The deposit from which the jaw was extracted is the 'black seam flinty gravel,' so called from its intensely dark (bluish-black) colour, arising from oxides of iron and manganese. It rests immediately upon the chalk, and belongs to what Prestwich calls the 'high level' series, being the oldest of the Somme Valley beds. A thin cake of black mangano-ferruginous clayey matter is interposed between the chalk and the gravel. If the jaw proved to be authentic, and came out of the alleged position, it indicated man, by an actual bone, at a period of extremely remote antiquity. The appearance of the jaw was entirely in keeping with the matrix, *i. e.* dark-coloured and fairly covered with a layer of it. A single detached human molar was found at the same time, corresponding exactly in appearance and matrix; and, to complete the case, a flint hatchet, covered with black matrix, was extracted from the same spot by M. Oswald Dunpre, who accompanied M. de Perthes. These details are all given in the 'Abbevillois' of the 9th instant.

"Two practised experts, Mr. John Evans and Mr. Prestwich, preceded me, on the 11th inst., to Abbeville, and their suspicions were instantly aroused. They pronounced the flint hatchets to be modern fabrications. I followed on the 14th, and got three of them out of the 'black seam gravel,' covered with matrix, and having every external appearance of reliability; but, on severely testing them on my return to London, they all proved to be spurious. M. Quatrefages, member of the Institute, and the eminent Professor of Anthropology in the Jardin des Plantes, got two of them in my presence from the same spot on the 15th inst. What they have proved to be I know not as yet, but I anticipate the same results. The number which turned out was marvellous, but the *terrassiers* were handsomely paid for their findings, and the crop of flint-hatchets became in like degree luxuriant.

"Now for the jaw itself. What complexion of intrinsic evidence did it yield? The craniological materials available at Abbeville for comparison were, of course, very limited; but the specimen presented a series of peculiarities which are rarely seen *in conjunction* in the jaws of European races ancient or recent. Here I must be a little technical. 1. The posterior margin of the ascending ramus was extremely reclinate, so as to form a very obtuse angle with the ascending ramus. 2. The ascending ramus was unusually low and broad. 3. The sigmoid notch, instead of yielding an outline somewhat like a semicircle, was broad, shallow, and crescentiform. 4. The condyle was unusually globular. 5. What was most remarkable of all, the posterior angle presented what I may venture to call a *marsu* al amount of inversion. The first three characters suggested to M. uatrefages—if I may venture to cite him for a preliminary impression d not a judgment—the recollection of something corresponding in the ws of Esquimaux, while the fifth character suggested to me the recollection what I had seen in the jaw of an Australian savage. Neither of us had hand the materials requisite for a satisfactory comparison, but the comnation of characters above alluded to struck us both as sufficiently rearkable to demand serious examination. M. Quatrefages departed for aris, taking the jaw with him, while I returned to London, bringing awings and a careful description with measurements of the principal ecimen, and M. de Perthes confided to me the detached molar. I may ld that the jaw specimen, although professing to have been yielded from low a heavy load of coarse flints, presented no appearance of having een crushed or rolled; and that, making allowance for the crust of maix enveloping it, the bone was light, and not infiltrated with metallic atter. The condyle washed yielded a dirty white colour.

"As to the result, I have as yet no authentic information of the final onclusions which have been arrived at in Paris. My friends, Mr. Busk, .R.S., and Mr. Somes, F.R.S., both practised anthropologists, gave me eir assistance in my part of the inquiry. The former, like M. Quatrefages and myself, was struck with the odd conjunction of unusual characrs presented by the jaw, and speedily produced a lower jaw of the ustralian type, brought by Professor Huxley from Darnley Island, which ielded the same kind of *marsupial* inversion, so to speak, with a nearly orresponding form in the reclinate posterior margin, ascending ramus, nd sigmoid notch. But Mr. Somes's abundant collection brought the natter speedily to a point. From the pick of a sackful of human lower aws, yielded by an old London churchyard, he produced a certain number which severally furnished all the peculiarities of the Abbeville specimen, *marsupial* inversion inclusive, although not one of them showed them all in conjunction. We then proceeded to saw up the detached molar found at Moulin-Quignon. It proved to be *quite* recent; the section was white, glistening, full of gelatine, and fresh-looking. There was an end to the case. First, the flint-hatchets were pronounced by highly competent experts (Evans and Prestwich) to be spurious; secondly, the reputed fossil molar was proved to be recent; thirdly, the reputed fossil jaw showed no character different from those that may be met with in the contents of a London churchyard. The inference which I draw from these facts is that a very clever imposition has been practised by the *terrassiers* of the Abbeville gravel-pits,—so cunningly clever, that it could not have been surpassed by a committee of anthropologists enacting a practical joke. The selection of the specimen was probably accidental; but it is not a little singular that a jaw combining so many peculiarities should have been hit upon by uninstructed workmen.

"The break-down in this spurious case in no wise affects the value of the real evidence, now well established, but it inculcates a grave lesson of caution. "Sir, your obedient servant,

"H. FALCONER, M.D., F.R.S.

"21, *Park Crescent, N.W., April 23rd.*"

The so-called fossil jaw from Moulin-Quignon has been taken to Paris by M. de Quatrefages, for the purpose of being submitted to the French Institute.

For our own part, we are indebted to M. de Perthes for his ready communication to ourselves of the intelligence of this find, and of the particulars of the deposit and the osseous remains; and we would add that if he has been made the victim of an exceedingly ingenious fraud by those workmen whom for years he has encouraged and liberally paid, we hope the proprietors of the quarry will reward their dishonesty and avarice, whenever it is brought home to them, in the summary manner they richly deserve. On M. de Perthes' side something is yet to be said; and if he has been led on by his enthusiasm to too implicit a belief in the workmen's veracity, he has kept back nothing, suppressed nothing, but has courted every publicity, and has done his utmost to secure competent witnesses for every phase of what he still considers an important discovery; if he should not in this case have that glory and good fortune he has so earnestly sought for so many years, the day will come when indeed his predictions will be verified, and we hope his life may be spared for that occasion, that his own hand shall draw forth from the gravel-beds their rare but precious proofs.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

MANCHESTER GEOLOGICAL SOCIETY.—*February 24th.*—Mr. Whitaker produced two horses' teeth and a flint arrow-head, which he said came out of the drift gravel at Barrowford, a few miles north of Burnley.

1. "On the Drift Deposits near Burnley," by T. T. Wilkinson, F.R.A.S. The drift deposits in the vicinity of Burnley, as well as those near Manchester, appear to possess several features of considerable importance, for, in addition to the usual clay and gravel, they contain pebbles and masses of foreign rocks, some of which are well water-worn, whilst others are so fresh and angular as to admit of scarcely any other explanation of their presence there than by iceberg-carriage from a great distance. A little east of the Four Lane Ends, near Blackburn, 650 feet above the level of the sea, the drift immediately overlies the Rough Rock, which crops out above the Corporation Park at an angle of about 75°. On the crest of this hill the blue clay, from which bricks have recently been made, lies upon the surface. It is, however, too much intermixed with sand, from the disintegration of the rock, to form good bricks. The pebbles and boulders contained in the clay appear mostly to belong to the Carboniferous formations, and their water-worn appearance indicates long-continued denuding action by water. Limestone and gannister pebbles occur in abundance; the former must have been drifted from a considerable distance.

Extensive deposits of yellowish sand occur opposite Portfield, near Whalley, 196 feet above the level of the sea; at Whittle Field, near Burnley, 451 feet above the level of the sea; and also at Healey Hall, on the slope of Burnley Moor, 580 feet above the level of the sea. Masses, or veins, of hard carbonaceous matter are occasionally found in this sand, probably indicating the remains of former vegetation; but as yet no shells have been detected in these deposits.

At the Quarry, near Habergham Hall, the sandstone rock immediately overlies the Dandy Bed of the Burnley coal-field. The surface of the rock is there covered with a coating of soft loamy shale, which soon passes into clay on exposure to the atmosphere. This shale is almost wholly composed of calamites, ferns, sigillaria, etc., indicating a profuse vegetation, which must have been covered by succeeding deposits in comparatively stagnant water. Above this shale there is a bed of dense blue clay, 22 feet thick, containing fragments of cannel coal, etc., the débris of still higher strata. Rough rock- and grit-boulders, portions of encrinital lime-ne, sometimes water-worn, together with rounded sandstone and lime-ne pebbles, occur in abundance, embedded in the clay, and the whole is rmounted by the remains of the denuded rocks which once occupied the xt position in ascending order.

In the quarries near Sandy Gate, Habergham Eaves, 462 feet above the rel of the sea, the drift is from 30 to 50 feet deep. It consists of dense ue clay at the bottom, and gradually passes into dark brown near the p. Large boulders of sandstone, similar to that which lies beneath, oc-ur in these deposits, few of which appear to have suffered from the action 'water. From their positions in the clay it may readily be inferred that ey may have fallen from the faces of the cliffs which then probably bor-ered the ancient seas. Portions of encrinital limestone also occur; and here is no lack of rounded fragments of cannel, together with sandstone, annister, and limestone pebbles.

In similar drift at Swindon, about two miles east of Burnley, 800 feet above the level of the sea, and just under the Pennine chain, large boulders of New (?) Red Sandstone are occasionally found in connection with abundance of rounded limestone. In former times the farmers have washed the drift in Swindon valley, and have burnt the limestone thus obtained in kilns, the ruins of which still remain in several places.

During the formation of a main sewer in Trafalgar Street, Burnley (1862), the workmen found a large boulder of grey granite. It was firmly embedded in yellowish clay, at a depth of about 15 feet from the surface. Encrinital limestones were also plentiful in this cutting. These deposits overlie the Thin Mine of the Burnley top beds; the cannel bed, which is the next in ascending order, having apparently been washed away.

In various localities extensive pebble-beds occur, indicating former beds of rivers, or the margins of ancient seas and lakes. Several of these bear evidences of powerful currents, which, from the set or inclination of the pebbles, appear to have flowed across the country in a N.E. to S.W. direction. This is very evident from an examination of the inclination of the débris in most of the sections previously noticed, but especially in one which exposes a portion of the grit series between Haslingden and Helmshore. This inclination of the stones, found in pebble-beds and drift deposits generally, appears to be capable of affording more information to geologists respecting currents, etc., than has yet been noted. Prior to the upheaval of the Pennine chain, a broad strait must have stretched across portions of Lancashire, Yorkshire, Durham, and perhaps Northumberland, thus connecting the present German and Irish seas; and the current through this strait must have run from N.E. to S.W., as indicated by the inclination of the pebbles and boulders in these drift deposits. Portions of floating icebergs from the north of Scotland, broken off from the edges of the glaciers, and charged with portions of granite and the older rocks, would then find their way down this channel, and becoming stranded in the shallow bays, would drop their cargoes of boulders among the silt at the bottom of the turbid waters. Red Sandstone boulders might perhaps be drifted in a similar manner from the neighbourhood of the Tees, or from the cliffs of what is now the Vale of York. Encrinital limestone, not water-worn, might also be transported from the north, by the same mode of iceberg carriage, to the deposits in which they are now found. Or again, if we adopt the conceptions of Sir Charles Lyell and Mr. Hull of the wasting of a vast North Atlantic continent, the same results would evidently be obtained.

On the gradual upheaval of the Pennine chain, the sea would consequently retire, both on the eastern and western sides of the country, leaving behind it those significant terraces which may be seen on the slopes of the hills abutting on the valleys of the Calder, the Hodder, the Ribble, and the Irwell, from about Ramsbottom to its various sources. The contents of these drift deposits also indicate several widely different conditions of things. There must have been many quiescent periods, and also many gradual depressions of the surface, during the formation of the various coal-seams, and the deposition of the rocks and shales by which they are overlaid. After the latest deposits there must have been a gradual upheaval, with occasional fractures, from the bed of a deep ocean, and, as the bottom came nearer the surface, the more powerful would be the currents, and hence the variable, but extensive denuding action of water which is everywhere apparent.

There is, however, good evidence that within the historic period the coast of Lancashire, at least, has again undergone considerable depression. In the times of the Romans there was probably no estuary of the Mersey. Ptolemy does not include this now-important opening in his topography of the coast. The dredging operations at Liverpool continually afford proofs of recent land-surface; and even hazel branches, containing nuts, were dug up from a considerable depth during the formation of the Sandon Dock. Along the shore from near Formby towards Preston, there are the remains of an extensive ancient forest. Many trunks of trees were exposed during the formation of the East Lancashire Railway, and are still to be seen in the pools on each side of the road. The roots of these are mostly below high-water mark, and in some places the trunks extend into the sea; but all of these must originally have flourished at a much higher elevation. About Southport they are so numerous, that they have been used to form ornamental fences for some of the gardens.

At Blackpool, and on towards Fleetwood, the sea is washing down the cliffs at the rate of about one yard in breadth per annum; and tradition states, on very probable grounds, that nearly half a mile, in breadth, of this part of the Lancashire coast has disappeared within the last hundred and fifty years. There are therefore strong reasons for supposing that Lancashire is at present undergoing a gradual depression. In Scotland, on the contrary, according to Mr. Geikie, the reverse operation is in progress, and it may form an interesting subject for some speculative mathematical geologist to inquire whether this apparent flexibility of the earth's crust is due to internal local action, irregularly applied, or whether it is the natural result of those mechanical laws which govern the earth when considered as a comparatively solid film resting upon a fluid interior.

In the discussion Mr. Hull said these discoveries of marine shells in the drift were very interesting; but there were also in the neighbourhood the more recent gravels of the valleys. These are of later date, and, according to the judgment of some, are most undoubtedly of the same age as the Amiens and Thames valley gravels, and many others which are yielding works of human art in different parts of Britain and the Continent; and he thought it very important that the attention of local geologists should be turned to the subject, because there is no reason, as far as we can see, why our river-terraces here should not yield flint-implements, and the remains of some of the extinct mammalia which appear to have been contemporary with man. With regard to the New Red Sandstone boulders which Mr. Wilkinson says are 800 feet above the sea, of course it would be improper to say they are not of this formation, but the identification is very questionable. He did not think the New Red Sandstone in the north of England attained to such a height. To suppose that boulders are carried from a lower level to a higher is a very unlikely thing indeed, except the special instance of coast-ice. These sandstone boulders are much ore likely to be Old Red Sandstone or millstone grit. That they have en brought from the vale of the Tees and across the Pennine chain in eir course to a higher level, is extremely improbable.

Mr. Binney said Mr. Whitaker had brought some of the veritable red ndstone, which he had no hesitation in saying was millstone grit or rough ck, from the neighbourhood.

Mr. Whitaker said the ravine from which these stones have come he new well. They are making a reservoir there, and the water-manager, t his request, brought down these boulders from the same heap that Mr. Wilkinson had examined. The course of the stream, from its source in the ills to the place at which the boulders were met with, runs over the out-crop of the millstone grit, many seams of which cannot be distinguished from these so-called New Red Sandstone boulders, but which, in his opinion, are nothing more than pieces of grit torn off and rounded by the force of the torrent; and so long as we have rocks near home that will account for these boulders, we are not warranted in going hundreds of miles away for them. If it be New Red Sandstone, it can only be found in any quantity as boulders, but it exists in any quantity *in situ* in the lower coal-measures. If he understood Mr. Wilkinson rightly, he speaks of the boulder clay having been deposited previous to the upheaval of the Pennine chain; but, from his own observations, he had arrived at an opposite conclusion, namely, that the land had much the same configuration then as now, with the exception of standing at a much lower level with regard to the sea. If, as stated by Mr. Wilkinson, the drift had been deposited upon a level plain, and the upheavals had taken place afterwards, the hills would have taken the boulder clay up with them, and we should have found it upon the tops of the highest of them. But such is not the fact. The drift can be traced to a height of from 1300 to 1400 feet, but no higher. Still, there is evidence that the sea of that time reached a height sufficient to submerge hills of from 1500 to 1600 feet. On Boulsworth, for instance, there are large numbers of enormous boulders, some of which, right on the crest of the hill, some 1600 feet high, are furrowed and grooved almost like gridirons, as if the icebergs had been stranded in floating across, and had grated upon the rocks strewn upon the bottom of the sea. But on Pendle we have an entirely different appearance. On the top we have no drift, nor any of the very large boulders that we find on Boulsworth. Growing on Pendle (1800 feet) is the semi-arctic plant *Rubus Chamæmorus*, which, according to the theory of the late lamented Professor Forbes, may be a relic of the glacial flora. The same plant may be seen on Whernside and Ingleborough, but he had not been able to meet with any traces of it on the lower ranges of hills, such as Bouldsworth or Hameldon; hence it is not improbable that hills of from 1500 to 1600 feet in height were submerged, but hills that approached to, or reached over 2000 feet, stood out as low islands in the cold and dreary sea of the Drift period.

Mr. Binney said the flint which Mr. Whitaker has now exhibited is a flint having certain chippings; and it may be taken as a moderately good example of an ancient arrow-head. It is of the same character, though rudely formed, as those which have, without question, been made artificially. It was found in the valley-gravel beyond Barrowford, and it is the very place where Mr. Prestwich and himself have been looking for them for some time. He should not like to say positively that this has been a portion of an arrow-head; but it is more like one than any other flint he had as yet seen in these beds. It is a chalk flint, and such are very rarely, if ever, found in these valleys. He thought they would be found n the gravel near Manchester.

Mr. Whitaker said about a few hundred yards further on, in the same valley, in sinking a foundation for a chimney some years ago, the workmen found several deer's horns and some bones, but they have probably been destroyed.

2. Mr. Binney read a translation of part of Dr. Geinitz's work 'On the Magnesian Limestone and Lower Red Sandstone,' by J. W. Kirkby, Esq., and himself.

Appended to the translation are the following Tables by Mr. Kirkby and Mr. Binney :—

TABULAR VIEW OF THE PERMIAN STRATA OF THE NORTH-EAST OF ENGLAND.

SUBDIVISIONS.	DURHAM.	SOUTH YORKSHIRE.
Bunter Schiefer.	*Red Sandstone* overlying the Magnesian Limestone in the S.E. part of the county ?—(Howse.) Thickness,—50 ft. ?	*Red Sandstone* and *Marl* near Doncaster and Tickhill—(Geol. Survey.) Thickness—50 ft. ?
Upper Limestone.	*Yellow* and *Oolitic Limestone* of Roker and Hartlepool; and *Botryoidal, Concretionary*, and *Crystalline Limestone* of Half-way House, Building Hill, Fulwell and Cleadon Hills, and coast from Whitburn to Marsden. Thickness—250 ft.	Brotherton Limestone of Brotherton, Knottingley, Womersley, Pickburn, Loversal, Wadworth, Tickhill, etc. Thickness—120 ft.
Middle Limestone.	*Shell Limestone* of Tunstall and Humbleton Hill, Ryhope, Dalton-le-Dale, Hylton Castle, Clack's Heugh, etc.; and *Concretionary* or *Pseudo-brecciated Limestone* of Galley's Gill, Tron Rocks, coast between Ryhope and Hawthorne Hive, etc. Thickness—150 ?	*Small-grained Dolomite* of Lound Hill, Vale of Went, Brodsworth, Cusworth, Levit Hagg, Warmsworth, Roche Abbey, etc. Thickness—200 ft.
Lower Limestone.	*Limestone* of Pallion, Millfield, Pensher, Newbottle, Houghton-le-Spring, Moorsley, Pittington, Sherburn, Ferry Hill, Summerhouse, etc. Thickness—200 ft.	*Limestone* of Pontefract, Emsall, Wentbridge, Hampole, Brodsworth, Barnsbro' Cliff, Cadeby, Conisborough, etc. Thickness—120 ft.
Marl Slate.	Marl Slate of Clack's Heugh, Down Hill, Midderidge, Ferry Hill, etc. Thickness—10 ft.	
Lower Red Sandstone.	Incoherent and Red Sandstone of Clack's Heugh, Hylton Castle, Tynemouth Cliff, Downs' Quarry, Sherburn, etc. Thickness—100 ft.	Red, Yellow, and Variegated Sandstones of Pontefract, Hickleton, Wentbridge, Cadeby, etc. Thickness—100 ft. ?
	Total thickness—760 ft.	*Total thickness*—590 ft.

Fig. 1.

Fig. 2.

1. AMMONITES VARIANS. 2. PLEUROTOMARIA PERSPECTIV.

From the Grey Chalk of Dover.

[In the Folkestone Museum: Mackie Collection.]

. Mackie del.

TABULAR VIEW OF THE PERMIAN STRATA OF THE NORTH-WEST OF ENGLAND, AS SEEN AT SHAWK, WEST OF CARLISLE, WESTHOUSE, SOUTH OF KIRKBY LONSDALE, AND MANCHESTER, IN THE DESCENDING ORDER.

	Shawk.	Westhouse.	Manchester.
	Feet.	Feet.	Feet.
1.*Laminated and fine-grained red sandstones	300	not seen.	not seen.
2. Red and variegated marls, containing sometimes, but not always, beds of limestone and gypsum, with fossil shells of the genera *Schizodus*, *Bakevellia*, etc.	150	traces of them seen.	300
3. Conglomerate	4	300	50
4. Lower New Red Sandstone, generally soft and incoherent	7	500	500
5. Red shaly clays	not seen.	250	not seen.
6. Astley pebble-beds, containing common coal plants, but quite unconformable to the upper coal-measures, termed by me Lower Permian	not seen.	not seen.	60

NOTES AND QUERIES.

CORRELATION OF THE GREY CHALK AND UPPER GREENSAND.—There is no more important point to be settled in the physical geology of the Cretaceous formation than the determination of corresponding horizons over different geographical areas of the Grey Chalk and Upper Greensand. The stratigraphical range of fossils in each, and the collating of those of both deposits from different localities with each other, would work out some important results. It is too much, perhaps, to ask our readers who live in chalk or greensand districts to send in lists of all the fossils they have collected,—although we should be very thankful indeed for such lists; but by drawing attention to two of the characteristic fossils of the Grey Chalk which we have figured in Plate X., we shall possibly receive through the kindess of our many friends, notices of the localities and strata in which they know them to occur. To note the beds and the places in which collectors have found these two shells will cost them a mere fraction of trouble, while the result will be an indication of considerable value in determining the conditions of deposits, and the possible synchrony of those two great deposits, and will help to bring isolated Cretaceous deposits into place in the chronological series.—S. J. MACKIE.

SUBTERRANEAN TREES AT PURFLEET.—Here (Purfleet) was a ferry over the Thames into Kent. That river made a breach and inundation at West Thurrock in the year 1680; at which time subterranean trees were washed out in as great numbers, and of the same kind of wood, as those found in Dagenham and Havering levels in 1707. (See Phil. Tr. No. 335, p. 478; and Abridg. by H. Jones, vol. iv. part ii. p. 219; and Morant's Essex, vol. i.)

FULGURITE NEAR MACCLESFIELD.—Besides the Mammalian bones from

* The first four strata of the above series, Professor Harkness, F.R.S., in a fine natural section seen at Hilton Beck, north of Brough, estimates to be of 3000 feet in thickness.—*Quarterly Journal of the Geological Society* for August, 1862.

this district, Mr. Sainter has sent us various other fossils he has collected there. Amongst them is a small part of a Fulgurite "found in the drift on the west side of the town, last December." "It was traced," Mr. Smith says, "thirty feet below the surface, and terminated in a layer or bed of soft marl. It passed through a bed of fine sand, almost perpendicularly. The diameter of the tube near the surface was nearly three-quarters of an inch. It gradually diminished in width in its descent, and towards its termination split into a number of finer tubes ending in points. Some parts of the tube possessed bead-like vitrifications on the inner surface, and it was contorted." Those who have read Dr. Gibb's interesting summary of this subject in Vol. II. p. 195, will be pleased to see recorded this additional example.—ED. GEOL.

PILOT KNOB, in Missouri, is a conical mound of a sugar-loaf shape, 550 feet in height, and covering 500 acres. According to estimate, it contains no less than 220,000,000 tons of iron ore, having 65 per cent. of pure metal in it.

NATIVE COPPER.—A mass nearly pure has recently been discovered in the Mesnard district, Michigan. It is 40 feet in length by 4 broad, and as many high; its weight is about 50 tons. Another great mass of copper has been met with in the same district, 15 feet 7 inches long, 3 feet 7 inches to 5 feet wide, and 18 inches thick; giving 87 cubic feet, or a weight of 23 tons. A small portion only of the mass, covered by moss and underbush, was above the surface when discovered. On removing the soil, pieces of charcoal, some stone hammers, gave traces of old Indian workings; the eastern end of the mass showing plainly that a portion had been broken off.

REVIEWS.

'*The Antiquity of Man:' an Examination of Sir Charles Lyell's recent Work.* By S. R. Pattison, F.G.S. London: Reeve and Co.

"The moral and spiritual teachings of the Bible would remain untouched, though it were proved that its histories must be restricted to one human period alone amongst several. But the supposition that there have been many such periods is contrary to our first impressions. The burthen of proof lies therefore on those who propose it." Thus opens Mr. Pattison's pamphlet, with a dictum no one would be willing to gainsay. This condition of proving what is contrary to popular, cherished opinion has been accepted by Sir Charles Lyell, who has adapted the evidence of the Antiquity of Man in his recent work to the support of one school of zoological theorists rather than to the deliverance to the public of the actual geological evidence as it is, or as it is viewed by at least very eminent sections of geologists and zoologists. To adapt all the evidence that came to his hand to his own purposes, and to the support of his own views, is no more than we should have expected of Sir Charles, who, in all his published works, has adopted this practice. Nor have we much to say against him on this score. If he belong to a party,—and he is always a partisan,—there is no objection to his doing all he can to advance their views; but a partisan draws down on himself a great deal of bitter antagonism. Perhaps Sir Charles has experienced more of this already than he anticipated. With personalities we have nothing to do in our reviews; our view goes to the science, not the man. Mr. Pattison objects to the yellian doctrines, and puts forth his own opposing views in a concise, lever pamphlet of twenty pages; and he assails his opponent at any rate ith righteous weapons. Mr. Pattison begins by putting Archbishop Jsher and the biblical chronologers against Sir Charles's arguments that nan has existed certainly 7000 years, probably twice as long, possibly four imes as long. Are these deductions warranted by the evidence? is Mr. Pattison's question, which he proceeds forthwith to answer. To the Lyellian arguments on the first point, that western Europe has been inhabited by man for more than 7000 years, Mr. Pattison quotes Sir Charles of old against Sir Charles of late, not always quite correctly to our mind, but generally fairly. His grand quotation attack—that Lyell formerly quoted from Gerard, the historian of the Valley of the Somme, that in the "lowest tier of that moss was found a boat loaded with bricks"—will not hold good in scientific argument. If the peat or the deposit on which a heavy-laden boat sank down were soft, there is no doubt that the boat would "swaddle" down to the very bottom of the soft stratum, be it mud or peat, until it rested on a hard bottom; and a boat sunk twenty years ago might even be dug out to-day from the lowest portion of a peat bog, or the oozy bed of a river. Mr. Pattison's reasoning on the age of the Danish peat, that the separate deposits of pine, oak, and beech were due to the successive surrendering to decay at distinct periods of woods of different hardness, is much more ingenious, and must more or less subject what has been hitherto written and said on the subject to further scrutiny. It is, however, this disregard of this element of the sinking of heavy bodies through soft and readily-yielding deposits that has given rise to the generally incorrect idea of "7000 years being sufficient for the growth of all the peat on the face of the globe." Thick beds of peat may be formed in such a space of time, but we must not thence conclude that all peat-beds have been formed in an equally short space of time. Mr. Pattison's remarks on cave-deposits, gravel, and brick-earth, are also very good, although we do not concur in his remarks on the absence of evidence of any changes in the shores of the British Channel within the Historic period, which would give a measure for the antiquity of the later post-Tertiary deposits on both sides of that "narrow sea." The legends of Cornwall and Brittany must not be lost sight of, as indicating great and very ancient changes, so remote, that the legends read now to us like myths. Neither must the traces of ancient forests, which the fishermen's trawls and the dredge bring up, be altogether forgotten or ignored. A British Association grant to an active explorer would bring out much singular information on this point.

"There is nothing," Mr. Pattison concludes, "in the ascertained facts of geology, nothing in the exhaustive volume before us (Lyell's), to forbid the hypothesis, that at some period after the final retreat of the glaciers man found his way into these regions as a wandering hunter, probably from a distant geographical centre; that he resorted to these parts at intervals during several thousand years; that its pebble-beds afforded him implements, and its grassy plains abundant game; that in the intervals of his occupation the earth was rent, in connection with volcanic action dying out in the Eifel and Auvergne, floods occurred, the loose materials of the surface were washed into crevices or spread out in heaps; that many of the great mammals became extinct, some so lately as the mammoth, whose flesh was found in ice at the mouth of the Neva. For upwards of 4000 years, all things were in course of becoming what they now are; and what they so became, they have remained, save surface accumulations and minor changes, for the last 2000 years and upwards. For aught that geology or palæontology has yet to show, this is as valid an explanation of the phenomena as that which, under the semblance of indefiniteness, is carefully definite for a long time before Adam. If it is physically and philosophically possible to intercalate all the epochs of man, shown in the monuments of the globe itself, within the compass of the years assigned to the same occurrences by the received interpretation of Scripture, my task is done. I claim the verdict of 'Not proven' on the issue raised."

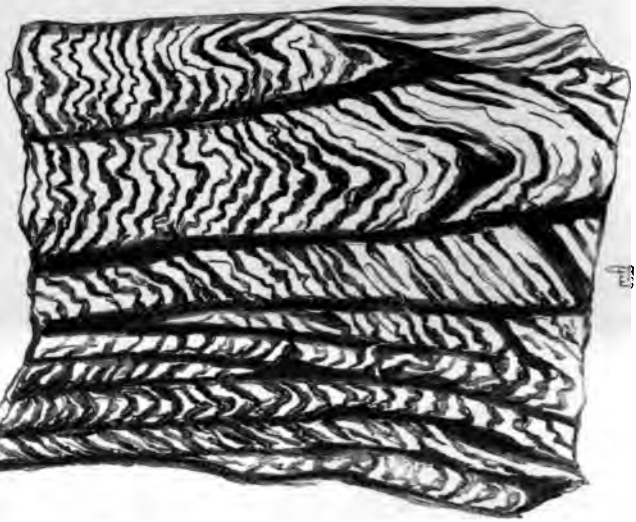
We do not side with Mr. Pattison's views, but we are willing to admit that no one of his school has put forward on any occasion more sensible or more critical objections than he has done in this unpretentious brochure.

Descriptions of two New Genera (Trypanostoma and Goniobasis), and of New Species of Unionidæ and Melanidæ. By Dr. Isaac Lea.

The enormous number of species in the genus Melania has made it desirable, Dr. Lea thinks, to eliminate as many as possible by founding new genera. The genus now proposed by him, Trypanostoma, will include all the Melaniæ with an auger-shaped aperture. For those having usually a slight thickening of the upper part of the columella and no callus below, and which are also without the notch of Haldemann's genus Lithasia, to which they are nearly allied, although subangular at the base, Dr. Lea proposes the generic name of Goniobasis.

M'Leod's Wall-Map, England and Wales: No. 3, Geological. By Edw. Weller, Esq., F.G.S. London: Longmans.

The sheet-maps of the Geological Survey, with their full details acquired by actual investigation in the field by competent geologists, and the general map produced by Professor Ramsay, the Local Director of the Survey, from the official materials of his department, leave no excuse for a bad geological map of England and Wales, nor much merit for producing a good one. Nothwithstanding these facilities, it is usual to find publishers producing geological, or rather ungeological, maps of the vilest character,—inaccurate in delineation, erroneous in geological subdivisions, and coloured fortuitously by some mere print-dauber. The wall-map before us, sent for our criticism by Messrs. Longman, however, deserves every praise. It is of convenient size—4 ft. 3 in. by 3 ft. 3 in.—small enough to hang on any ordinary school-wall or library without inconvenience, large enough for the particulars to be seen at a considerable distance; it is accurately delineated, and nicely coloured. The details inserted are quite sufficient for ordinary purposes, as is also the stratigraphical section of subdivisions, which acts as a key to the colouring. Altogether we can conscientiously recommend it as the best map of the kind extant. No other for scholastic purposes can be compared with it at all. In the copy we have received, two or three patches are omitted to be coloured, an oversight which should be seen to by the editor or publisher, as such omissions, which occur through the stupidity and carelessness of the colourers, are detrimental to the high character the map ought to possess with the public.



RIPPLE-DRIFT STRUCTURE IN MICA-SCHIST.

From a Specimen collected between Arroquhar and Tarbet. (Nat. size.)

[In the Collection of H. C. Sorby, Esq., F.R.S.]

S. J. Mackie del.

THE GEOLOGIST.

JUNE 1863.

RIPPLE-DRIFT IN MICA-SCHIST.

By the Editor.

Of all English geologists, Mr. Sorby has been at once the most indefatigable and the most successful in the study of the microscopic structure and metamorphic conditions of rocks. The brief abstract furnished us by the Geological Society, which we print at p. 231, gives but little idea of the importance of the paper Mr. Sorby read last month. It gives, it is true, the pith of the subject, but so short and inexplanatory a paragraph is not likely to attract such attention as the paper deserves. Those who have the pleasure of Mr. Sorby's acquaintance know how persistently he works at anything puzzling which comes in his way. He never leaves it until he has got to the solution of the riddle. It happened some time ago, when in Germany, at the meeting of *savants* at Speyer, on which occasion he transmitted an account of the proceedings, with some notes on meteorites and sponges (see Vol. IV. p. 501), that Professor Blum presented him with a specimen of the singular conglomerate known as the "nagel-flue." This conglomerate, which occurs in some places in Switzerland, consists of hard limestone pebbles, the ends of some being impressed into the substance of others,—a condition hitherto inexplicable, although Blum, Von Dechen, Escher von der Linth, Nöggerath, Daubrée, and others have essayed opinions and suggestions, some of them attributing the impressions to merely mechanical, others to purely chemical action. In working out this investigation, Mr. Sorby eliminated evidence of a new phase in the correlation of physical forces; and in an able and valuable paper recently read before the Royal Society, showed the evidence of a *direct* correlation between mechanical and chemical force. This new phase of the direct correlation of those forces is destined undoubtedly to have a wide influence on that branch of geological research that attempts to explain those various phenomena which are the results of rock-masses having been subjected for long periods to pressure, and during which such mechanical force must have modified materially those chemical changes which were dependent on the slow action of weak affinities.

This subject is, however, only incidental to our present topic; but just as the study of these curious "nagel-flue" pebbles has brought us the knowledge of a new phase in the correlation of forces, so the knowledge of the direct correlation of mechanical and chemical force will soon manifest its influence in increased knowledge of metamorphic conditions. Already we have the germ before us, in Mr. Sorby's observations on the presence of ripple-drift in mica-schist; for the presence of that structure shows former sedimentary origin.

While standing under the shelter of some rocks during a shower of rain, Mr. Sorby saw, on their wetted surfaces, some markings which struck him as being the more or less contorted lines of that peculiar kind of deposition which, in his former accounts of the intimate structure of rocks, he has called by that term. "When ripple-marks are found," he says in a communication to ourselves, "whilst material is being deposited, a structure is generated which I have called 'ripple-drift' in various papers published on the subject. It might very well happen that no fracture of this could show any 'ripple-marking,' properly so called, but yet it is so peculiar and has so many characteristics, that one could not confound it with any structure produced by other means. If we were to find what looked like ripple-marking in mica-schist, we could not be sure that they were not some of the mere mechanical bendings so common in that rock, and hence we ought not to base any important conclusion on their occurrence. However, the structure of ripple-drift is so different from anything that could be produced by any other means, that its occurrence in mica-schist must be looked upon as a most convincing proof of the sedimentary origin of that rock. In some cases the micaceous schist of the Highlands of Scotland show this structure to great advantage; and there can be little or no doubt of its nature; but in other cases the very great disturbances which have produced so many contortions in the rock, have so modified the arrangement that it is only by care fully following all the transitions from simple to complicated that the true nature of some of the contorted bands of ripple-drift can be understood. In no other way can we explain the various curious structures that are met with in some localities, as, for instance, the neighbourhood of Arroquhar, whence I have a number of specimens prepared so as to show the structure in a very striking manner. The value of the fact of the occurrence of the ripple-drift consists in its proving so very conclusively that the schists were originally deposited in the same manner as ordinary sedimentary rocks, under the influence of gentle currents. Moreover, in studying the microscopical structure of various mica-schists, one may see some of the original grains of sand, although since somewhat altered, and may clearly perceive that the present characters of the rock have been produced by a general crystallization of the various constituents, so as to give rise to what is known as a metamorphic rock. In one thin microscopical section proofs were exhibited of all the leading facts of metamorphism. We had the evidence of deposition from a gentle current of water, of subsequent compression, and of the alteration of the whole into a highly crystalline rock."

The specimen of ripple-drift in mica-schist which we figure in Plate XI. is from between Arroquhar and Tarbet, and our engraving is from a drawing which Mr. Sorby has kindly sent us. "It was," he says, "somewhat difficult to convey the true character of the rock, but will be more easy on a wood-block, for it is really a white pattern on a black ground. You must bear in mind that the small black stratula pass completely into the larger bands. I mean the, stratula in the line

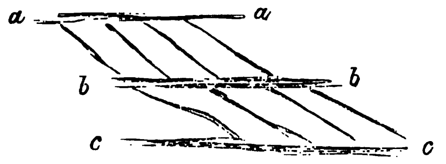


Fig. 1.—Stratula passing into larger bands.

a, *b*, *c* are continuous with *a a*, *b b*, *c c*. (See Fig. 1.) Also, these dark stratula become thicker near the junction, or, as is really the case, the white bands of quartz, which were originally sandy, thin out at the ends. Of course you understand that, in the case drawn, the whole has been much disturbed and greatly contorted, the only part at all in its original state being the right-hand side of the central band, where I have drawn a hand pointing." (See Plate XI.)

Without wishing at present to go into any discussion of the subject of central heat, we can but rejoice at the acquirement of this evidence of the former sedimentary origin of this highly metamorphosed rock; and we sincerely hope that it will not be long before we have more proofs of the like nature. Heat *may* have had much influence in effecting metamorphic changes, but we think it far more likely that water, mechanical pressure, and chemical action have been the principal workers in metamorphic action. The curious sections of encrinital limestone which Mr. Sorby exhibited at the last Royal Society soirée, showing how mechanical pressure and chemical action had caused the solution or removal of the material of the encrinital joints on the one side, while on the other deposits of other materials had taken place, gives indication how such processes could affect rock-masses on a large scale; and while geologists are demanding heat to reduce to a pasty condition our metamorphic rocks, why, we would ask, might not such mechanical and solvent actions, by removing obstructions to motion on the one hand and permitting a deposit of material on the other, be a slow but sure way of bringing the integral particles of rocks into crystalline forms or into parallelism with each other, so that every form of metamorphism, and even slaty cleavage, might be thence produced?

By natural and *existing* phenomena we should attempt, in the first place, to elucidate geological conditions. Cold water is much more abundant than hot; it does a great deal. We have no real knowledge now of any deep-seated dry heat-action going on. We may imagine such; but I much doubt if the mechanical, chemical, and crystalline forces, combined with the solvent power of water, are not quite sufficient to produce very many of those effects we have been in the habit of assigning to the internal fires.

ON THE OLDER PARIAN FORMATION IN TRINIDAD.

By R. Lechmere Guppy.

In the Report on the Geology of Trinidad the Government geologists described a series of sandstones and shales extending across the island from east to west, and occupying an extent of about 97 square miles. The distribution of the formation, which has been named the "Older Parian," is in the manner of an irregular band of from 1 to 4 miles in breadth, traversing the island in an easterly direction from the Gulf of Paria at Pointe à Pierre. This band terminates rather abruptly before reaching the east coast, but the formation reappears here and there near the south coast along a line parallel to the main band.* The formation is only exposed for a short distance on the shores of the Gulf of Paria; but it has been found to cover a large area, and to be extensively developed on the continent of South America. The fossils found by the geologists in Trinidad seem to have been few, and for the most part indeterminable. They however obtained fossils from the same formation at Cumana, in Venezuela; and these remains led to the belief that the Older Parian was probably of Neocomian age. During a short visit to Pointe à Pierre I obtained several fossils, which have enabled me to make the observations detailed in the present paper.

The section given by the Government geologists of the Older Parian deposits at Pointe à Pierre† is taken on the south side of the point, which I have not had an opportunity of examining carefully. The geologists do not seem to be able to give much attention to that portion of the deposits which is exposed on the north side of the point, and I hope that the present paper, in so far at least as it relates to the fossils, may in some measure supply the deficiency.

The extreme point of the cliff at Pointe à Pierre is formed of a hard ferruginous sandstone, which is somewhat brittle and coarse in its structure, and contains no fossils. The dip is from 40° to 45° south. The beach north of the point is passable at low water, and consists of pieces of rocks more or less rounded, which have fallen from the cliffs above. Going north along this beach, we find alternations of sandstone of variable quality, with shales of a black colour and thin unconsolidated layers of very fine sandy matter, some of which are black and some nearly white. It is only, however, at the north end of the beach that I have been able to detect organic remains. The most conspicuous of these is a *Trigonia*, considered to be the same species as that found at Bogotá, and named by D'Orbigny *T. subcrenulata*.‡ Of this fossil, I have found one entire specimen and several disunited valves.

Mr. Etheridge notices the entire absence of Cephalopoda in the collection made by the geologists when there, stating that the want of such fossils prevented a comparison with the strata at Bogotá and in other parts of South America.§ I have obtained a specimen of *Belemnites* from Pointe à Pierre, so very imperfect and worn however, that it is difficult to ascertain to what section of that genus of Cephalopoda it belongs. If, however, it belongs, as is perhaps probable, to Brown's section Acæli, it furnishes additional evidence of the correctness of Mr. Etheridge's determination of the age of the strata exhibited at Pointe à Pierre as Neocomian. The presence of the Belemnite is at once a proof of the Mesozoic age of the Older Parian group; and, as Belemnites are not found above the Chalk,

* Report on the Geology of Trinidad, p. 34.

† Ibid., sheet no. 2, fig. 2.

‡ Ibid., p. 163.

§ Ibid. See also Wall, "On the Geology of Venezuela and Trinidad," Quart. Journ. Geol. Soc. vol. xvi. p. 460 *et seq.*

we must consider the Pointe à Pierre deposits as undoubtedly equal to or older than the true chalk.

Numerous fragments of an oyster somewhat like *Ostrea carinata*, a fossil of the Lower Greensand, are found with the Trigonia. I have not however been able to obtain a perfect specimen. At the same locality I have found oysters referable, perhaps, to two other species. One of these is a good deal like the recent *Ostrea edulis*, and one of my specimens shows the markings of the hinge cartilage very distinctly. I have also found a single valve of a deeply sulcated bivalve, which may be an Avicula, but which presents some resemblance to a fossil described by Von Buch as a Pecten under the name of *Pecten alatus*.* My specimen, however, has fewer sulcations than the shell described by Von Buch, and the absence of wings makes the determination somewhat uncertain. It is possible, however, that the shell in question may be a young specimen of *P. alatus*.

Gasteropoda are also represented among the fossils from Pointe à Pierre, but the specimens are generally so imperfect as to render the determination of their relationships difficult. A cast in my possession, upwards of 2 inches in length from the apex to the peristome, seems to be of a naticoid type. Another cast, which has some shelly matter remaining on it, is very like a cast figured by Von Buch as a Rostellaria, and may belong to the same species.†

A single valve, embedded in a calcareous nodule, from Pointe à Pierre, appears to have belonged to a Plagiostoma, while a massive gibbous valve about 2½ inches in length, has some of the characters of a Cytherea; but that genus is not common in rocks of such ancient date. Amongst the fossils collected by me, are several other fragments of Mollusca, which appear to be indeterminable. Still, though there is much doubt respecting a great part of the fossils yet collected from these deposits in Trinidad, enough has been discovered respecting them to confer a character of greater certainty on the presumption of the age of the Older Parian deposits in this island than has been previously attained to.

All the fossils I have been able to obtain from Pointe à Pierre have been from the beach; consequently, they are usually much worn, and it is hardly possible to ascertain from what portion of the group they have been derived. The Trigonia and the oysters are tolerably well preserved, as far as their structure goes; but the shells of the Gasteropoda have nearly disappeared. The thick and massive character of the shells is worth notice, and it prevails alike in all the specimens in which the test is preserved.

From what I have said in this paper, it will be seen that the palæontological evidence is in favour of Mr. Etheridge's view‡ of the age of the deposits termed "Older Parian" by the Government geologists. Until, however, more fossils can be obtained, and their position in the series better determined, it will be as well to leave

* Von Buch, 'Pétrifactions recueillies par Humboldt,' pl. i. figs. 1, 2, 3, 4.

† Von Buch, 'Pétrifications,' pl. ii. fig. 27.

‡ Report on the Geology of Trinidad, p. 163.

he precise age of the formation an open question, and to remain atisfied for the present with having arrived at the conclusion that he Older Parian deposits in Trinidad, and the rocks of similar age n South America, cannot be newer than the Gault.

List of fossils found by the Government geologists in the Older ?arian at Cumana:—*Pteroceras*, *Cerithium*, *Turritella*, *Trigonia sub-renulata*, D'Orb., *Astrea Couloni*, *Arca*, *Cardium*, *Echinus*.

Those found in Trinidad since the survey, and alluded to in the ibove paper, but not included in the foregoing list:—*Belemnites*, *Ros-ellaria ?*,* *Natica ?*, *Cytherea ?*, *Plagiostoma ?*, *Pecten alatus ?*,† *Ostrea*, 2 sp.

DESCRIPTION OF A LAND SURFACE UNDERNEATH THE DRIFT ON THE COAST OF SUFFOLK; OBSERVED IN 1859.

By S. R. Pattison, Esq., F.G.S.

The low cliffs stretching from Gorleston, south of Yarmouth, towards Lowestoft, are mainly composed of boulder drift, and are well described by the late Mr. Trimmer in the Quarterly Journal of the Geological Society for 1857. As an independent confirmation of his observations on the intercalation of the whole boulder-clay double series, between the fluvio-marine and forest bed beneath, and the local marls and marsh and estuary beds occasionally above, I send the following note, made without having had the benefit of Mr. Trimmer's paper.

On the beach under Corton the section is as follows:—

	Feet.
Mould	2
Disturbed ferruginous sand	10
Alternations of gravel and sand, frequently interchanging. Gravel well rounded and small. Large masses of dark clay entangled in the gravel with lumps of chalk. Small rolled pebbles of chalk, boulders of slate rock, coal-measures, greenstone, red sandstone, oolites (very abundant), having an average depth of	30
Clean brown sand, with occasional very small pebbles	40
An irregular bed of peat, surface and contents of marshes, compressed rush-like plants matted together, and much mineralized with sulphate of iron	2
An irregular surface below the bog, covered with roots and lower portions of stems of ferns (Pteris ?) *in situ*, in a dirt-bed; occasionally large trees	5
Dark clay, with a greenish tinge, underlying the heath-like de-	

* Perhaps the Pteroceras of the Geological Survey. † Possibly an Avicula.

posit above, abounding in Cyclas, opercula of Bithynia ?, and traces of other Planorbis-like shells, very small flint-pebbles and occasional peaty layers 4

Total 93

CORRESPONDENCE.

Age of Prehistoric Man.

Sir,—In Professor King's valuable paper on the "Glacial and Post-glacial Deposits," in the 'Geologist' of last month, the learned author of this most interesting paper says: "The genus Homo belongs to both the glacial and post-glacial period; it was represented as early as the close of the subaqueous epoch, or the beginning of the second subaerial division of the glacial period, by a low form or extinct species, a view strongly countenanced by the Neanderthal skeleton, as well as the rudely chipped flint-implements occurring in the elephant-gravels of Amiens, Hoxne, and other places. Probably a higher type existed at the same time, as indicated by the skulls found in the Engis caves near Liége."

I must venture to express an opinion that the theory which assigns the Engis and Neanderthal skeletons to any particular division of the glacial period is scarcely warranted by the facts before us. Without wishing to throw any doubt on the demonstrated antiquity of the Engis skull, of which the age is fully proven, in the words of Huxley, to carry us back to the "further side of the vague biological limit which separates the present geological epoch from that which immediately preceded it," I would wish to ask what is the geological or palæontological proof of the following propositions:—

1. That the Neanderthal skeleton was probably coæval with the remains from the Liége caverns.
2. That it was coæval with the "high-level" flint-implement gravels of the Somme valley or of Hoxne.
3. That the species of man to which it belonged is extinct, *i. e.* different from a race having the same general cranial character as some existing Australians.

Sir Charles Lyell, in his 'Antiquity of Man,' remarks justly that the Neanderthal skull has given rise to surprise "because, having no such decided claims to antiquity [as the skull from Engis], it departs so widely from the normal standard of humanity;" and concludes his remarks on the evidences thus: "If we conceive the [Neanderthal] cranium to be very ancient, it exemplifies a less advanced stage of progressive development and improvement. If it be a comparatively modern race, owing its peculiarities of conformation to degeneracy, it is an illustration of what the botanists have called 'atavism,' or the tendency of varieties to revert to an ancestral type, which type, in proportion to its antiquity, would be of lower grade."

The fact cannot be too prominently brought before us, and must again be borne in mind, that no flint-implements or any other works of art were found in the Neanderthal cave, and that the tusk of bear which was found

* Page 80. † Page 92.

ıme level as the human skeleton has not been identified with any r extinct species; likewise that the depth in the mud or loam (five k in all) in which the skeleton was found has not been recorded. *ori* probability would lead biologists to infer that pithecoid man sted on this planet; but in the present stage of the controversy it r opinion, most hazardous to frame a table on the mere probability t.

Yours very truly,
C. CARTER BLAKE.

The Portland Fissures with Human Remains.

-Will you allow me to make some remarks on the letter of Mr. ı the 'Geologist' of this month, in which he seems to doubt the ess of the facts which I mentioned in my letter in the 'Geologist' ıonth, that the remains of man and of extinct mammalia have been ıingled together in fissures of the rock of Portland Island, which do not extend to the surface of the rock?

'hole question depends, of course, on the nature of evidence which :ed of the truth of these facts. My first evidence was the testi- the writer of an article in 'Willis's Current Notes' for the month st, 1852, who had himself visited Captain Manning, at Portland He states expressly—on the authority, of course, of Captain Man- ıat on several of the ledges, in the fissures of the Portland rock, o not extend to the surface-soil by 5 or 10 feet, a number of all kinds of animals have been found, including those of the human The truth of this statement has been in the fullest manner con- o me by Captain Manning himself, who showed me, at the Castle, ction of bones, which were those of men, the elk, the reindeer, the :, etc. He said that the fissures in which they were found did not o the surface of the rock. He also said, what is stated in 'Willis's Notes,' that Dr. Buckland, who visited him at the Castle, being acted to the island by the discovery of a fossil boar's head, having ıs to the place where the bones were found, accompanied him to re, where a lad was let down, who brought up more of the bones esence.

ıext evidence which I produced was an article in the 'Times' of of last January, relating to the fortifications recently built in l Island. The article states that in these fissures, "commencing) feet below the surface of the ground, human bones have been ith those of wild boars, and horns of reindeer, not fossilized, but their osseous structure as perfect as if they were not fifty years 'he high preservation of these bones proves that they must have l entirely excluded from the air from the time that they entered stone formation to the period of their discovery.

ıe facts which I have mentioned be disproved,—that human and ıan bones have been found in fissures of the Portland rock, which xtend to the surface of the rock? If these facts are true, which easily ascertained by any person's visiting the island, they prove, ı doubt, that the human and mammalian bones must have been :d in the rock *before* its consolidation, and consequently, that the l animals to whom they belonged must have inhabited some other l, probably now destroyed.

, what can explain the association in the fissures of the bones of leer, an arctic animal, with those of a tropical animal, the elephant,

... same spot from arctic and trop... them in the Oolite formation ... For arctic and tropical animal ... the same climate. The association of ... has also been observed in other ... in a mass of loam or di... have been ... the remains of the mamm... reindeer, a sp... their bones not yet dete... M. Cuvier remarks, that "the ... and the hyæna, the rhinoceros and th... caverns, as we observe at Gaylenreu... the same diluvium, as we ... either a state of the ear... imply in these animals a te... now display." The ... the hyæna, elephant, elk and ... been found in the quarries of K...

... animals, whether found in ... are almost always embedded in ... was deposited by a ... suppose that, as I have alre... their present situations by a ... such opposite climates ... the same climate.

I am, Sir, your obedient servant,
THOS. D. A...

... 22, 1853.

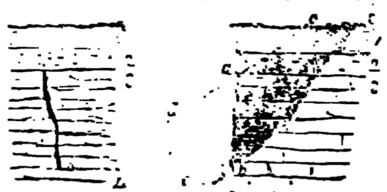


Fig. 1. Fig. 2.

Fig. 1 shows the vertical face of the quarry, with a fissure, *a b*, *apparently* ... solid beds 1, 2. Fig. 2 shows the same fissure in section passing diagonally ... the beds to the surface.

SIR,—With ...
of two hun...

has induced me to believe that they were not in the un-
-rick-earth, but in the lower part of the bed which lies immedi-
t, consisting of washed brick-earth, the run of the hill. In this
at this particular point is between 7 and 8 feet in thickness and
wards the N.E., there is a great difference between its upper
ortions, for about 4 feet from the upper surface it contains a
quantity of flints, below that they are less frequent, and disap-
approach the true brick-earth. At first sight, there seems to
or no difference between the lower part of the rain-wash bed
e brick-earth. Also, from the men that removed the soil im-
ver the skeletons, I found that there was distinct evidence that
disturbed, for part of the upper portion of the bed was found
th the lower; that and the fact that the stone was between the
lose to the skulls, would tend to show that they had been buried
gh perhaps at some remote period.

I remain, yours sincerely,

H. F. Rivers.

lla, Luton, Chatham, May 25. 1863.

Holoptychius and Glyptolepis.

SIR.—Will you allow me space for a few remarks on communi-
ich have recently appeared in your pages, and which have been
at least by [illegible] mine?

t, as to the [illegible] of Pteraspis. I intended that in my second
ie poster[illegible] the test should be marked off by a dotted
line. I [illegible] the exact position of the spine, and
erefore [illegible] portion, although specimens of it
from [illegible] possession. Mr. Pearce's beautiful
clearly [illegible] the [illegible]. But
at [illegible] the [illegible]
nd which [illegible]
our [illegible]
d the [illegible]
ous. I [illegible]
but I [illegible]
diagram [illegible]
shield [illegible]
rence. I [illegible]
g with my [illegible]
g some of [illegible]
er.

ien, as to the case which has been so [illegible]
Holoptychius v. Glyptolepis,—I [illegible]
the Quarterly Journal of the [illegible]
noticed in the [illegible]

cade' by so correct an observer as the author of it, I was disposed to think that these might be scattered scales of Glyptolepis lying there. I have looked at them again, and now believe them to be in their original position, or at least slightly displaced. I am afraid that Holoptychius, unless the other points of difference hold, will have to go down before the kindred Glyptolepis; but without determining the issue, I have simply sought to place on record what I had observed in the slab dug some years ago from Dura Den. *Quantum valeat.* Yours truly,

HUGH MITCHELL.

Craig, May 6th, 1863.

The Lincolnshire Flats.

SIR,—A letter, headed "The Antiquity of Man," which appeared in the 'Times' newspaper of April 16, 1863, from Mr. J. A. Clarke, of Long Sutton, will, it is to be hoped, direct the attention of geologists to the marsh and fen countries in the east of England. As he happily expresses himself, "these districts interlace archæology with geology;" and in confirmation of this, I would offer to you a few remarks upon one small portion of the marsh, on the east coast of Lincolnshire: that portion lies in the parishes of Orby, Addlethorpe, Ingoldmells, Hoggsthorpe, Burgh, and Thorpe. I speak more particularly of the first three parishes, any few observations that I have myself made referring to them, and what I know of the others, being more from hearsay.

I was a frequent visitor to the seacoast of Lincolnshire in years past, and my attention was called to certain nodules of burnt clay, called by the country people "hand-bricks," because they almost all bear the impression of the human hand, as though they had been grasped by it. Many fanciful ideas have been attached to their origin and use; but very little examination is sufficient to determine that they are the refuse of some manufacture of pottery, and have been used as props to support earthenware, and give access and circulation to the flames in the kiln. The like pieces of clay have, as an antiquarian informed me, been found in some of the Channel Islands, and a paper upon them exists in some periodical or transactions of some society. The use of these "hand-bricks" being pretty clear, I paid no further attention to them, until the subject of the works of "man primæval" began to be mooted, when the age of these bricks became an interesting question. I thought it worth while to make a few excavations on spots where the bricks were known to exist, and to try what could be learnt further about them. In the autumn of 1861 I made some fourteen or fifteen diggings, commencing under the strongest impression that the nodules were of very remote antiquity. The first excavation confirmed the view I had taken of the use to which they had been applied they were surrounded by the débris of pottery, lying in every position as if they had been thrown aside as useless and done with. As I proceeded I found nothing that threw any light upon the age of the hand-bricks until the workmen, in almost the very last spadeful of the last excavation threw up the bottom part of a pot, which, much to my disappointment bore the marks of the wheel, and was clearly a piece of Roman pottery. The use, then, of these bricks, which may have been settled perhaps without my knowing it, is apparent; but their age I never heard any one hint at. They are Roman, and of no greater antiquity than the time of the sojourn of the Romans in Britain.

The men who dug for me recognized, as they said, the same appearance

" "clay ashes" as are seen in the "staddles" or "straddles," where ricks are burnt in the present day in the marsh. I never myself, however, could discern a single piece of charred wood, however minute, or of oal, or any cinders, or any indication of vegetable matter acted upon by re. I have an idea that the fuel used may have been straw or dried rass. Nothing was turned up of the nature of metal, coins, or tools; iere were several drop-like pieces of a dark blue, almost black, glaze, ransparent; the tooth of a horse; one of the tarsal bones of an ox or cow; wo or three imperfect bones, probably of sheep; the remains of hazelrees and willows, on the same level as the bricks: also, on the same level, ockle-shells, as though in their native bed; single oyster-shells; and, in ne place, land-snail shells, as fresh and brilliant in colour as any now in a edgerow.

In some few cases the hand-bricks are vitrified and hard; those that re not (constituting the great bulk of what I turned up) vary in colour rom a light yellow-red to a dark black-red, and all seem more or less to ave chopped grass or hay mixed with them. They vary in size; the maller are near to Orby, the larger to the seacoast; the small ones are ery friable and easily crumble. Flat pieces of pot-like floor-tiling exist, earing the impress of grass on both sides, and seem to have formed a loor on which the props rested to support the pottery. Many of the ricks show a flat surface at one end, whilst the other end, that rested against the pot, is slightly hollow; there are other pieces of pot, of the use of which I could form no opinion. These relics of the Romans lie at very little more than a foot below the surface in Orby, at the point most distant from the sea; at other places they are three, four, five, six, and even close upon seven feet under the present marsh-level.

The superincumbent warp forms the rich marsh-grazing district of Lincolnshire. When examined, it can be split up into flakes, indicative of its being a tidal deposit, exactly like the warp left by the Trent and Ouse (Yorkshire) in the present day. I did not see a single freshwater or marine shell in the *body* of the warp; but when it is pierced through, a well-defined surface is reached having sea-shells upon it, and this surface was doubtless the Roman level.

I do not possess sufficient geological lore to reason firmly on the fact I have next to state; but the professed geologist will perhaps at once explain my difficulty. The first digging I ever made was in a field in Orby, the property of Mr. Stainton, of Dolby, called "the far ten acre." At about four feet we reached the bed of hand-bricks and débris, which were found to rest on a fine blue, plastic, saponaceous-like *clay*, into which a pole was thrust for three or four feet with ease. This clay must certainly have been the level of the district in the time of the Romans, for the hand-bricks lie upon it; it must, therefore, have been deposited *before* the Romans came to England, at all events before they made pottery on its surface, and very possibly out of its substance. If this clay is a sea deposit, which I take it to be, how comes it that the sea deposited a *blue* clay *before* the Romans came to Lincolnshire; and *after* they had left this country, when the banks gave way and the sea again submerged the Roman level, a *yellow-brown* warp, a very widely different substance from the blue clay, was left behind by the very same sea? Can any supposition of the blue clay being a freshwater deposit clear this up? Any such supposition appears to me to militate against the received, and I think the true idea, that the sea (not fresh water) once covered the Roman level, and that it was the sea, and not fresh water, that was embanked out by the Romans.

A considerable portion of the existing sea-embankment at Ingoldmells and Addlethorpe is not Roman, but modern, requiring constant attention. One of the hand-brick beds passes under this sea-embankment, and crops out upon the shore near to a house (formerly a public-house) now occupied by Mr. Waller. This spot cannot always be found, owing to the sands moving about with the state of the weather and tides, being sometimes covered for weeks and months, and sometimes left bare and exposed for like periods. The marsh in the time of the Romans, or rather the Roman level, is thus proved to have extended out into the sea, or what is now sea. At this spot the submarine forest is visible at low water (spring tides), and cannot, I think, be more than from twelve to sixteen or twenty feet below the level on which the hand-bricks rest, and may be much less. At this part of the coast there is, as Mr. Clarke says, a complete interlacing of archæology and geology. At low water you have the marine forest, admitted on all hands to have undergone geological depression, standing, as I believe, on a blue clay. What intervenes between the forest and the level of the hand-bricks I cannot say, but I believe it also is blue clay; whatever it is, on it rest the hand-bricks; and finally, over them is deposited the sea-warp, forming the marsh-land of East Lincolnshire.

I fear I am trespassing too much on your columns. I will only add that the bricks picked up upon the seashore are indifferent specimens, having always suffered from the action of the sea; if more is required to be known about them than their use and date, which I think are clear, it must be obtained from diggings made between Orby and the sea.

In writing to you, my object is to support Mr. Clarke's views. I feel confident that whoever will make researches in the district of Orby, Ingoldmells and Addlethorpe, will find much that is curious, whether he is an antiquarian or a geologist, and very likely contribute his mite to the common fund of knowledge. Yours obediently,

G. S. D.

Lincoln, April 23rd, 1863.

New Species of Olenus.

Dear Sir,—I have much pleasure in informing your readers that a new species of Olenus, named *O. pecten* by Mr. J. W. Salter, has been found in the Black Shales (Lingula flags) of Malvern by a village schoolmaster, Mr. Turner, of Pauntley, near Newent. Mr. Turner was so good as to present me with his newly-discovered treasure, and I have given this beautiful little trilobite to the museum at Jermyn Street, and the cast to the museum at Worcester; so at either of these places the student of Silurian geology may see the specimen. I may also mention that I was presented last month with some well-preserved bones—the humeri, I imagine, of the Labyrinthodon—by Henry Brooks, shoemaker, of Ledbury. This specimen I have also sent to the Worcester Museum.

I mention these facts, as they are encouraging to those geologists and naturalists who are engaged in such constant occupations as day-school keeping and shoemaking, and who have little leisure or time at their disposal. Yours very truly,

W. S. Symonds.

Pendock Rectory, Tewkesbury, May 6, 1863.

Causes of Cosmical Changes of Temperature on our Planet.

t is admitted that the possible changes in the present meteorological ditions of our planet could not account for the great fluctuations of temature recorded in the geological history of the glacial periods. Mr. J. Mackie, in the last number of the 'Geologist,' attributes these nges of temperature to changes of size of the sun's disk, to maximum l minimum periods of solar heat, etc. etc. It is clear these explanations, ıough possible, are purely arbitrary, mere speculations, unsupported by r cosmical or physical facts. Now, it is known that our solar system is velling in space towards the constellation Hercules at the rate of 57½ es a second; yet so great are star-distances, that thousands of years pse before our visible position in the heavens be changed to the naked :. From the observations of Glaisher in his balloon ascents, it appears .t the decrease in temperature is not in direct proportion to the distance m the earth; but, on the contrary, that a hundred feet elevation at the 'th's surface produces as great refrigeration as a thousand feet at a :ater elevation. It necessarily follows that we must arrive at cosmical nperature beyond the influence of atmospheric changes; but is this smic temperature uniform through the portions of space destined to be ıversed by our solar system? If there be portions of space of different smical temperatures through which our planet has passed, this would count for the great cold of the glacial periods in a way supported by one rong fact, which is, that our position in the heavens is changing at the te of 57½ miles a second, and for this change of position not to affect the :at of our earth, we must suppose the cosmical temperature of space so aversed by our earth to be uniform, which would be a most arbitrary ıpposition. It is quite possible, nay even probable, that not only our wn solar system, but all visible creation, the infinite and countless stars,— remote, that their light has taken millions of years to come to our eye,— :e all revolving through space around some almost infinitely far-off centre, hich if luminous, its light is so attenuated by distance as to be invisible us, and that the period of such a revolution may be long, beyond all lculation, during which immense portions of space must be traversed, ıost likely of unequal cosmic temperature, quite sufficient to account for ıe glacial periods in the geological history of our earth. There is nothing ınciful in this view, or beyond the range of probability. The vast magniıde of such a system is no objection to its existence, for, in comparison ith infinity, all assignable distance or magnitude shrinks into a mere oint. The immense period necessary for such a revolution would afford nple time for all the glacial formations recorded by geological observaon, by admitting only the natural supposition that the temperature of ıfinite space is not uniform. Yours, etc., DAVID LESLIE, M.D.

Carrickmacross, Ireland, May 21, 1863.

[It is not the intention of the Editor to reply to comments on his articles in all cases parately, but in one or two respects Dr. Leslie's letter requires notice. Mr. Mackie stinctly put forward the views in his paper as *speculations*; but Dr. Leslie is wrong saying they are all unsupported by physical or cosmical facts. Neither is it admitted ıat possible changes of meteorological conditions could not have produced the cold of ıe glacial era. It may have been dogmatically asserted so. We should be glad to arn what temperature Dr. Leslie thinks existed then, and what were the fluctuations it as subjected to. We should also be glad to know on what grounds the idea of hot ıd cold regions in space can be maintained; and why the cosmical temperature of space ıould not be the real zero of temperature, or a condition of absence of all heat. We ıould like to know what is the presumed temperature of the cold cosmical space through hich our globe is so hypothetically supposed to have passed in the glacial age.—ED. EOL.]

FOREIGN INTELLIGENCE.

The Abbeville Human Jaw.

When we noticed last month the discovery of a human jaw at Moulin-Quignon, we did so with the utmost caution. We knew perfectly well how long and how keenly M. Boucher de Perthes had sought for human relics in the gravels around Abbeville, and we could scarcely believe that the indefatigable collector, who for thirty years had resided on the spot, could not know the difference between a spurious and a real fossil. On the other hand, we had the letter of Dr. Falconer to the 'Times' before us, and Messrs. Prestwich and Evans, after a journey of inspection and examination, had returned disclaiming the discovery. We seemed thus compelled by adverse testimony to repudiate the discovery; but still we were not satisfied with the premises upon which the adverse conclusions had been founded, neither, on the other hand, could we advocate the genuineness of either the jaw or the flint-implements, for there were circumstances connected with both that made us hesitate. The flint-implements, although of the usual size, namely, six or eight inches long, were not left as usual in their natural state and unworked at the broad end, but were clipped all round; and the strong point urged by Dr. Falconer, of the presence of gelatinous matter inside the solitary molar, which was supposed to have fallen from the jaw, was, though not conclusive against the fossil, still a barrier against an advocacy of the genuineness of that specimen, and, by inference, of the jaw. Since then, M. Quatrefages has made his report to the Paris Academy of Sciences, and has unequivocally declared in its favour. M. Quatrefages' first communication was made to the Academy on the 27th of April, and the following notice of it was given in the 'Institut:'—

"M. de Quatrefages brought then before the Academy a very interesting palæontological fact—the discovery of a lower human jaw, in the same diluvial sands at the base of which have been found during some years numerous worked flints, thanks to the incessant researches continued with such indefatigable zeal by M. Boucher de Perthes. M. Quatrefages submitted for the inspection of the Academy the jaw itself, surrounded still with a part of the matrix which enclosed it. It was at Moulin-Quignon, near Abbeville, that the discovery was made in the deposit already many times quoted in the publications of M. Boucher de Perthes, and of which the natural or undisturbed state is universally admitted by geologists, both French and foreign, who have visited the locality. M. de Quatrefages had been informed of the discovery, and M. Boucher de Perthes had requested him to communicate it to the Academy, but he would not do this until he had seen it with his own eyes. He went to Abbeville as soon as possible, and met there Dr. Falconer, with whom he proceeded to make a first examination of the human jaw. The two naturalists then visited the localities and proceeded to make a sort of inquiry. Dr. Falconer had already been to the quarry of Moulin-Quignon. M. de Quatrefages now descended into it in his turn, and clearing away the soil himself to make certain of getting at earth not attacked by the workmen, he struck into it with a pick. Soon he perceived amongst the detached gravel-stones a first *hache* and almost immediately a second. He would have continued his search but that the excavation was already so deep that a slip or falling-in was dreaded; it was prudent to stop. The next day Mr. Brady found in the same place a fourth implement.

M. de Perthes wishing to confide to M. de Quatrefages the precious

·lic, the latter has made a detailed examination of it. . . . At present it is ıfficient to indicate the following general results :—M. de Quatrefages is ›nvinced that the jaw discovered by M. Boucher de Perthes belongs ·ally to the bed in which it was discovered. It is then a fossil, in the ·neral sense of the word. Geologists discuss still the age of these beds. [. de Quatrefages, who is not a geologist, declines entering this part of ıe question, and only occupies himself with the anthropological phase. ı this point of view, the characters of this jaw have nothing remarkable. he differences which separate it from analogous parts in existing races, ·e less than those which can be noted between one and the other of the tter. This jaw is not that of a negro, and it presents absolutely nothing hich would support the theory that would make man to be descended om the ape by means of a progressive development."

This communication appearing almost simultaneously, but irrespectively f, the letter of Dr. Falconer to the 'Times' which we printed in our last umber (p. 189), M. de Quatrefages returned again to the subject at the ext meeting of the Academy on the 27th of April, and, referring to the oubts of Dr. Falconer and the English geologists, critically re-discussed he circumstances and the grounds for these doubts, asserting that he ould find nothing in the latter that could withstand a profound examina- ion.

The only right thing which could be done under these circumstances has ɔeen done. A congress of *savants* has been held to discuss and decide the ɥuestion. They first met at Paris, but transferred their assembly on the 11th of May to Abbeville itself. The congress consisted of M. Milne-Edwards, member of the Institute, and senior member of the Faculty of Sciences, to whom the presidency of the meeting was unanimously awarded; M. de Quatrefages, member of the Institute, and professor of the Museum of Natural History; M. E. Lartet, member of the Geological Society of France; M. E. Delesse, engineer of mines, and professor of geology at the Normal School; the Marquis de Vibray, member of the Institute; M. E. Hébert, professor of geology at Sorbonne; M. J. Desnoyers, member of the Institute, and Librarian of the Museum of Natural History; the Abbé Bourgeois, professor of geology at the College of Pont-Levoy; Dr. F. Garrigall, member of the Geological Society of France; M. Albert Gaudry, naturalist at the Museum of Natural History; M. J. Delanoue, member of the Society of Antiquaries of France; M. Alphonse Milne-Edwards; Dr. Falconer, Fellow of the Royal Society, and of the Geological Society of London; Mr. Prestwich, Fellow of the Royal Society and of the Geological Society; Professor Busk, Fellow of the Royal and other Societies; Dr. Carpenter, Fellow of the Royal Society and Professor of Physiology at University College, etc. The result of the inquiry was, that the Congress admitted that the jaw found on the 28th of March, by M. Boucher de Perthes, at Moulin-Quignon, is truly fossil; that it was extracted by M. Boucher de Perthes himself from a virgin and undisturbed bed; and that the implements that it had been supposed had been fabricated by the workmen are incontestably ancient.

The *savants* of both nations united in a deputation to convey the intelligence, and to congratulate M. Boucher de Perthes. The local newspaper, the 'Abbevillois,' says :—" We cannot too highly applaud the scrupulous care these eminent men have given to this interesting inquiry on a point so important to our history, and confirming all that tradition tells us of the Biblical deluge, and of the existence of man at the epoch when that great cataclysm altered the face of the earth. The English members of the commission, and we thank them for it, have shown a real devotion to science in quitting their business to join the French professors and aid them with their opinions. The frank cordiality, the good faith and impartiality that they have shown in the discussion, is above all praise. . . . Dr. Falconer, the great English palæontologist, and Messrs. Prestwich and Busk, whom all the world know by their fine works, have gained for themselves much honour. Our town ought to be proud of the *réunion* within its walls of such men, so justly esteemed in France, as well as in England. On the 14th, M. de Cailleux, member of the Institute, and director-general of museums; Professor Edward Collomb, the well-known mineralogist; M. Hébert, who had already come to the deliberations of the 12th, and other Parisian notabilities whose names we regret we do not know; and lastly, a party of pupils of the learned professor of the Sorbonne have arrived and visited our beds, now become so celebrated, and the galleries, not less known, of M. Boucher de Perthes. We see that this discovery of antediluvial man, which in other times would have passed unperceived, has become a truly scientific ceremony.

"In the sciences, as in everything else, the slightest circumstance may serve to resolve a great question. Mr. Busk, the celebrated English chemist and naturalist, who came to Abbeville with Messrs. Falconer and Prestwich, making, on the 12th of this month (May), some experiments on the argillaceous 'black bed,' which contained the jaw and *haches* from Moulin-Quignon, let fall on the ivory handle of his penknife a drop of the black earth wetted with water. On the morrow it had dried, and presented a metallic reflection. Having washed it, he perceived that the handle of the knife remained perfectly white. This explained to him the non-coloration of the implements, and the whiteness which had been preserved in the interior of the jaw. This earth, having no staining or penetrating qualities, could not alter their surfaces. Mr. Busk immediately acquainted Messrs. Prestwich and Falconer, who concurred with him and adopted his opinion. It was this appearance of newness, which however is not an unusual case, that on his (former) return to England had engendered the (then) conviction of Dr. Falconer. He believed, for a time, in a *ruse* of the workmen; but, equally conscientious as learned, and never recoiling from the truth, the eminent palæontologist exhibited a real joy when his doubts were dissipated and he was able to proclaim the innocence of the workmen. Honour should be rendered to Dr. Falconer, who, in this discussion, in London as in Paris and at Abbeville, has given proof not only of a profound knowledge but of a probity and courage which French and English alike admire.

"Messrs. Prestwich and Busk, Dr. Carpenter, and Mr. John Evans, although the latter could not come to France to this second meeting, have shown the same dignity of character. We applaud these men, who thus do honour both to science and to their country. Amongst those who have thrown most light in this discussion must be mentioned the president of the commission, M. Milne-Edwards, M. de Quatrefages, the celebrated professor of anthropology, and M. E. Lartet, who for five-and-twenty years has made such great progress in palæontological investigations. These gentlemen have supported, without ever varying, the authenticity of the human fossil and the antiquity of the *haches*.

"A very simple incident had tended more than anything else to enlighten M. de Quatrefages. M. Boucher de Perthes had, on the 28th of March, extracted the jaw from its bed before numerous witnesses. The workmen, who expected to see some monstrous bone appear, as at Menchecourt, were confounded at the apparition of so small an object, and which, enveloped in its *gangue*, did not even appear to them to be a bone at all. M. Boucher

Perthes having disengaged a part from its envelope, made them seek for e other half, and gave them five francs, promising them double if they und the other half or any other portion of the skeleton. This offer he s renewed many times, and even offered treble the first. However, though they have made many researches, they have not since the 28th of arch brought to M. Boucher de Perthes a single fragment of human bone. ow, doubtless, if they had buried the first, they would have largely sup- ied afterwards, not only M. Boucher de Perthes, but all the amateurs who ve asked for specimens."

With regard to this last proposition, we do not however see the force, cause if the workmen had been encouraged by rewards—as indeed they d been by M. Boucher de Perthes—to find human remains, a solitary ull was much more easily obtainable by them than a whole skeleton, and bit of jaw much more so even than a skull; and, therefore, it might be the other hand said that the not finding of further remains was confir- atory of a *ruse* having been practised. The force of the discovery does t however rest on this point. The question is not a question of sus- cion against the workmen but of positive evidence from the witnesses ho saw M. de Perthes extract the jaw from its bed. These witnesses ust be trustworthy or not; either they did see the jaw in its matrix efore extracted, or they did not; either they did see M. de Perthes take out from thence, or they did not. What do these witnesses say? What oes the world say of them? Were they not capable, intelligent, honour- ble men,—not illiterate bumpkins whose eyes and tongues we might esitate to believe?

For M. Boucher de Perthes himself nothing can be more open, more traightforward, than his conduct; and the same, we think,—whatever be the tate of the jaw or the conclusions we may come to from its study,—must e said of the workmen. They knew that every fragment of bone, even f animals, was deemed of value by their patron, and as soon as they saw n inch of bone appearing in their diggings they go and tell him; they do ot call it human, they make no fuss about it. M. de Perthes goes to see it. He goes to see every bit of bone they tell him of; he may have gone similarly scores of times before, but this time he perceives, as any educated man would do, that he has got a bit of a human jaw; the workmen, xpecting some great bone of mammoth or other ancient wild beast, are stonished at its smallness, still more so to learn what it is. M. Boucher le Perthes orders it not to be disturbed, not to be touched; he fetches the most competent of his friends, members of the local but well-known Société d'Emulation, men at least capable of using their eyes and of giving truthful and accurate testimony; and in their presence he clears way the soil and takes out the jaw, leaving the still adherent earth upon it. Certainly, if such a discovery is to be ignored on suspicion, it will be hard o accept any fact at all in quaternary geology, and not half the facts in geological science which are based on far less conclusive testimony. If e object to the testimony in this case, we could only get better by finding he jaw over again.

The 'Moniteur' also comments on the late scientific tourney. It says: 'The human jaw which has been recently found near Abbeville, in the liluvium,—a geological bed in which hitherto no similar vestige has been liscovered,—has been photographed by M. P. Potteau, preparator at the Museum of Natural History, to whom we owe already an interesting col- ection of types of different human races. We have before us two proofs epresenting the two faces of this curious relic of a generation whose ex- istence dates, in all probability, beyond the historic period. It is the half only of the inferior maxillary, in a state of preservation really extraordinary according to the observations which have been made, and which we owe to the good offices of M. de Quatrefages. This jaw belonged to an aged man of small size; which would prove that the human race did not possess at its origin those gigantic proportions which some hypotheses have assigned. The angle of the exterior contour is more open (obtuse) than in modern types; but in examining two Esquimaux jaws, it was seen that in one this angle was much more open still, and in the other much less. This is then only a character belonging to the individual. A molar tooth, which remains in place, appears also more inclined forwards than in ordinary cases; but this fact is explained by the absence of the neighbouring tooth, which had been extracted or had fallen out during life; for the process of ossification had taken place, as it always does, in the alveolus. This then again is only an entirely individual character. Other important observations which can be repeated, or the photographic portrait itself, have given the like result.

"The discovery of this fossil jaw has given rise to a veritable scientific tourney between the French and English *savants*. If the victory has been gained by the former, their adversaries have had the rare merit, in duels of this kind, to acknowledge loyally and courteously their defeat. To give an idea of the minuteness of the investigations to free the matter from any doubt which might exist, we summarize some of the curious details which have been kindly furnished by Messrs. de Quatrefages and Milne-Edwards, jun.

"After having examined the jaw found by M. Boucher de Perthes, M. de Quatrefages went to Moulin-Quignon, where he made some cuttings to study the earth. He caused the quarry to be cleared, and gave in front of himself a blow of the pick in its wall (or face) at the height of the bed where the discovery had been made. Stones were detached, and amongst those which fell was found a flint *hache*, like those of which we possess already numerous specimens. On examining the wall in the gap which had been thus made, M. de Quatrefages saw then nearly entirely embedded a second *hache*, which he detached himself. This, at least, could not have been fraudulently introduced, and its presence was a guarantee for the authenticity of the human débris found in the same place. Hence the learned Professor made his first communication to the Academy of Sciences. Dr. Falconer came to Paris, studied the implements and the jaw, and went away convinced. However, after some days, and fresh observations, he published in the 'Times' the letter we have read,* and which expresses more than a doubt. M. de Quatrefages took then the study he had made, and replied by new and critical arguments to his *confrères* across the Channel. They decided then they would come to Paris, to undertake, in concert with the persons that were named, investigations which M. Milne-Edwards had spoken of in his communication to the Committee of Learned Societies.

"Three principal points formed the basis of the doubts of the English Professors,—the nature of the *gangue* which enveloped the jaw and the implements, the freshness of the edges of the latter, and finally, the presence of a little sand in the alveolus where the dental artery passes. M. Delesse declared it was impossible for any chemist to counterfeit exactly the material of the *gangue*. This, moreover, had penetrated into the alveolus, and had there deposited itself in a way it was not possible to imitate. Five implements were found successively in the presence of the parties conducting the inquiry, and they all† had the same characters as

* Printed in our last number, p. 189.

† With one exception, see p. 223.—Ed. Geol.

ose previously extracted. Lastly, at the top of the 'black bed,' where e maxillary bone reposed, a sand was found exactly like that noted in e alveolus.

"After these evidences, the English *savants* declared themselves connced that the jaw had not been introduced fraudulently in the bed of luvium, and that it was contemporary with the material which formed at bed.

"As to the question as to what is the age of that deposit, that remains be resolved.

"Thus has terminated this interesting debate."

Since Dr. Falconer's return to England, he has communicated the following letter to the 'Times' of the 21st ult., and which we give at length, the appendix he has thought fit to make to the unanimous conclusions f the congress must open afresh the question of the age of the Moulin-Quignon deposits:—

"SIR,—In my letter which appeared in your issue of the 25th ult., I tated that the case of the Moulin-Quignon human jaw presented in its hen stage, as a whole, 'one of the most subtle instances of perplexed evidence on a point of science that has come under my experience.' It has since undergone an investigation at Paris and Abbeville by a joint commission of French and English men of science, throughout which it maintained the same perplexed and contradictory character, not to be surpassed, in some respects at least, by any *cause célèbre* on record. But I am happy to say that upon one point, which it was of the last importance to clear up, the commission, French and English, were unanimous,—namely, that the discovery of the remarkable human relic *in situ*, in the gravel-pit of Moulin-Quignon, was authentic, and that no imposition had been practised by the workmen in the case. As an inference to the contrary on the part of myself and my scientific friends was distinctly expressed in my former letter, I am desirous that there should not be the slightest reserve in withdrawing it. What now remains to be established is the precise age of the relic. This part of the case is still involved in obscurity, and so beset with contradictory and apparently incompatible evidence, that its satisfactory solution is at the present moment of the utmost difficulty.

"The voluminous *procès-verbaux* of the commission will appear in due course. Here I shall merely give a brief summary of the proceedings, prefacing it with a short *résumé* of the events which led to the conference.

"On the 14th, 15th, and 16th of April, I was at Abbeville, where, on the 14th, I met Dr. Carpenter, and on the 15th M. Quatrefages. I communicated to both my then impression, subject to the reserve of a more detailed study of the materials, that the jaw was an authentic fossil, and on the 15th I wrote to the same effect to my friend M. Lartet, to whom the jaw was consigned in Paris. On the 16th Dr. Carpenter gave a short paper to the Royal Society, supporting in guarded terms the authenticity of the discovery; and on the 20th of April M. de Quatrefages communicated to the 'Institut' a memoir by M. Boucher de Perthes, followed by descriptive remarks by himself, conveying the high authority of his opinion in favour of the jaw being a true fossil of geological antiquity. On Saturday, the 18th, immediately after my return to London, I commenced the scrutiny detailed in my former letter, and on the 21st, in conjunction with, or aided by, Mr. John Evans, Mr. Prestwich, Mr. Busk, and Mr. Tomes, I arrived at the results which are there stated. That day, without the delay of a post, I communicated my suspicions to M. Lartet, requesting him to make them, and the grounds upon which they were founded, known to M. de Quatrefages. But the latter had already given in his affirmative memoir to the 'Institut' the previous day (20th), followed on the 27th ult. and 4th inst. by successive notes in the same sense. On the 25th of April, my letter, written before I was aware of M. de Quatrefages' first communication, appeared in your columns. Men of science in France and England were thus suddenly placed at direct issue on a grave and important point, which excited lively general interest on both sides of the Channel. But, happily, from the frankness and rapidity of the communications interchanged, there existed the most cordial relations, and the conviction of loyalty and good faith on both sides. The French *savants*, the more they went into the case, were the more convinced of the soundness of their conclusions, while their English opponents, the more they weighed the evidence before them, were the more strengthened in their doubts. A wordy discussion on paper would have wasted time, and it must have been protracted. On the 15th inst. I received an invitation from M. Lartet to proceed to Paris with my colleagues, and Dr. Carpenter got one from M. de Quatrefages to the same effect,—the parties named were Messrs. Prestwich, John Evans, Carpenter, and Falconer,—to discuss and investigate the question, along with M. de Quatrefages, member of the Institut; M. Lartet, member of the Geological Society of France, and foreign member of the Geological Society of London; M. Delesse, Professor of Geology to the Ecole Normale, Paris; and M. Desnoyers, member of the Institut. Dr. Carpenter and myself at once determined to accept the invitation, and Mr. Busk agreed to accompany us. Unfortunately, Mr. Evans, the strength of our array on the characters of ancient flint-implements, could not go, and Mr. Prestwich was unable to join us until the second day of the conference. The English deputation reached Paris on the 9th inst., and immediately proceeded to business. The commission was formed, consisting of the parties above named, aided by the following French *savants*, who took a share in the proceedings throughout, viz. M. l'Abbé Bourgeois, M. Gaudry, and M. Alphonse Milne-Edwards. At the request of the English, M. Milne-Edwards, member of the Institut, and the eminent zoologist, courteously agreed to preside over the commission. The following particulars are given from notes and recollection, we not having yet received a copy of the *procès-verbaux*.

"The first two meetings, one of which lasted nearly six hours, were devoted to the characters which distinguish genuine flint-implements of antiquity from modern imitations. The English deputies presented about twenty flint *haches* from the gravel-pit of Moulin-Quignon, and the majority of them found within the last three months, the whole of which they insisted bore the characters of comparatively modern manufacture, so great was their freshness and sharpness, while they were wanting in the *patina*, superficial incrustations, dendrites, and rolled edges, one or more of which, as a general rule, stamp the majority of genuine specimens. The French members of the commission submitted nearly an equal number of a similar cast from Moulin-Quignon, the majority of which also the English regarded as unauthentic. A few specimens from Moulin-Quignon, but of earlier discovery, were presented and admitted as genuine on both sides.

"The 'detached molar' which had previously been sawn up by me, and upon which so much weight was rested by the English observers, was at once abandoned, by the consent of both sides, from the circumstance that it was open to question on the score of identification, or of certainty as to its origin. This in the sequel proved to be immaterial.

"The characters presented by the jaw itself were then examined. The

·k matrix enveloping it (mangano-ferruginous) was regarded on the one e as being natural, while on the other it was urged that it might have ·n laid on artificially. The jaw was carefully sawn across by Mr. Busk, l the section so conducted as to include a portion of one of the fangs of solitary tooth. The black coating was washed off readily by means of ponge, and the residuary spots in the minute hollows were removed by aid of a tooth-brush. The general colour of the washed surface was ight buff, mottled with brown stains. The outer surface was tolerably ooth, presenting little indication of the superficial erosion commonly n in old buried bones. There was no appearance of dendritic patches her on the exterior or within, and no infiltration of metallic matter. e substance of the bone was dry and friable, especially towards the eolar border; but, on the whole, it was tolerably firm under the jaw, d the fresh section afforded a distinct odour of sawn bone. The in-nal cancellated structure was of a faint brownish tinge, and the cells e from any incrustation. The most remarkable appearance observable the section was the lining of the dental canal with a thin layer of fine ey sand, free from admixture with the black metallic matrix which ocked up the orifice of the canal below the condyle. The section of the ng showed that the dentine, so far as exposed, was white, and in no re-ect different from that of a recent tooth. The enamel was white and illiant. The socket towards the upper part was not completely filled by e fang, and the interval was partially occupied by black matrix and ndy particles. The above descriptive remarks are extracted from the tes of Mr. Busk. The commission was too pressed for time to wait for chemical analysis.

"Here terminated the labours of the commission at Paris on the 11th st., and, so far, no point had been established to shake the confi-nce of the English members on the soundness of their doubts as to the thenticity of the flint *haches* and of the human jaw. Two, at least, of e four French members frankly and openly admitted the effect which e evidence yielded by the section of the latter had produced on their ews; and had the inquisition been carried no further, it is probable that e result would have been a verdict of 'not proven.' But, happily for e interests of truth, the President, M. Milne-Edwards, had, after the se of the second *séance*, proposed that the commission should visit bbeville, to examine on the spot the evidence as to the *gisement* in which e *haches* and the jaw were asserted to have been found. From the mo-ent when the commission got to Abbeville, the whole aspect of the case s changed. A party of sixteen workmen were employed from 7 a.m. 5 p.m. with pickaxes, under the closest inspection, to cut into the un-turbed body of the section, and during the course of the day five flint *ches* were discovered *in situ* under circumstances which made it impos-le to doubt the authenticity of their natural position in the cliff. I was eye-witness, with many others, to the disengagement of two. And at struck the English members with especial force was, that of these e *haches* only *one* presented the characters which they held to, as dis-ctive of genuine specimens of great antiquity; the other *four* were entical in their general appearance with those which in the previous etings of the conference they had considered to be unauthentic. If the rmer were adjudged to be authentic, the decision carried with it the tter which had been rejected. The evidence regarding the occurrence the jaw in the 'black band' was then considered, and it appeared to be pported by such direct testimony, that it was unanimously accepted by e commission.

"During the last two days the English members were reduced to three, Dr. Carpenter having returned to London. At the final meeting, held on the 13th inst., the following conclusions were adopted:—

"'M. le Président, après avoir résumé la discussion, met aux voix les conclusions suivantes:—

"'1. La mâchoire en question n'a pas été introduite frauduleusement dans la carrière du Moulin-Quignon; elle existait préalablement dans l'endroit où M. Boucher de Perthes l'a trouvée le 28 Mars dernier. Cette conclusion a été adoptée à l'unanimité.

"'2. Tout tend à faire penser que le dépôt de cette mâchoire a été contemporain de celui des cailloux et autres matériaux qui constituent l'amas argilo-graveleux, désigné sous le nom de 'couche noire,' laquelle repose immédiatement sur la craie. Cette conclusion a été adoptée par tous les membres présents, à l'exception de MM. Falconer et Busk, qui réservent leur opinion jusqu'à plus ample informé.

"'3. Les silex taillés, en forme de haches, qui ont été présentés à la réunion comme ayant été trouvés vers la même époque dans les parties inférieures de la carrière du Moulin-Quignon, sont pour la plupart, sinon tous, bien authentiques.

"'Cette 3ème conclusion a été adoptée par toutes les personnes présentes sauf par M. Falconer, qui réserve son opinion jusqu'à plus ample informé.

"'4. Il n'y a aucune raison suffisante pour révoquer en doute la contemporanéité du dépôt des silex taillés avec celui de la mâchoire trouvée dans la 'couche noire.'

"'Cette proposition est adoptée par tous les membres de la réunion sauf par MM. Falconer et Busk, qui désirent réserver leur opinion.'

"Before signing the *procès-verbal*, I handed in to the President the following memorandum, to be appended to the report, as embodying my opinion upon the whole case:—

"'I am of opinion that the finding of the human jaw at Moulin-Quignon is authentic; but that the characters which it presents, taken in connection with the conditions under which it lay, are not consistent with the said jaw being of any very great antiquity. 'H. FALCONER.

"'*Abbeville, May* 13.'

"Mr. Busk also handed in a memorandum, differently worded, but virtually to the same effect as regards the question of antiquity.

"The above is a bare outline of the principal features of this remarkable inquiry. The full discussion of the bearing and import of the conflicting evidence on the various points, and of the geological questions involved in the case, must be given elsewhere. It will be seen that in the judgment of some of those concerned in it the question of the antiquity of the relic still remains to be determined.

"I have only to add that we were received, both at Paris and Abbeville, by the eminent French *savants* with whom we were brought in contact, in the most cordial and friendly spirit; and the conviction was reciprocal that, throughout, both sides were influenced solely by an earnest desire to arrive at the truth. Sir, your obedient servant,

"H. FALCONER, F.R.S.

"21, *Park Crescent, N.W., May* 19.

"P.S. Dr. Carpenter, although named as a commissioner, both in the French and English accounts of the proceedings, wishes it to be understood that he took no part in the discussion upon the flint *haches*, as to the genuineness of which he did not consider himself competent to form an opinion; but he had been sufficiently impressed by the unanimous conviction of the English experts as to their modern character, to have come to doubt his original belief in the authenticity of the *jaw*. H. F."

We will now return to M. de Quatrefages' paper before the French Academy, as the particulars are interesting, and one point is worthy of some consideration.

"The jaw was found . . . in an undisturbed quaternary deposit at Moulin-Quignon, near Abbeville. Below is the section of the beds :—

"SECTION AT MOULIN-QUIGNON.

	Metres.
1. Coating of vegetable earth	0·30
2. Undisturbed earth, grey sand mixed with broken flints . . .	0·70
3. Yellow argillaceous sand mingled with large flints slightly rolled, resting on a bed of grey sand	1·50
4. Yellow ferruginous sand, flints more or less rolled like the preceding, below which is a bed of sand less yellow. In this bed have been found fragments of teeth, etc., of *Elephas primigenius* and flint-implements	1·70
5. Black sand, argillo-ferruginous, colouring the hand and adhering to it, apparently containing organic matters; small pebbles more rolled than in the superior beds; fossil human jaw . .	0·50
	4·70

6. Bed of chalk on which reposes the bed of black argillaceous sand at a depth of 5 metres below the surface.

"The argillo-ferruginous bed in which the jaw was found varies in places from 0·30 to 0·60 metre in thickness. No part of it is confounded with the beds above, and it follows all the undulations of the chalk under it; thus it may be said to lie at a depth of from 4 to 5 metres from the surface. . . .

"The jaw is in a remarkable state of preservation. It does not appear to be at all rotted. The extremity of the coronoid apophysis itself is intact. This fact would make one think it had not come from far, and would give the hope that there may yet be found some other part of the skeleton of which it formed part. M. de Perthes has desired that the greatest respect may be paid to the *gangue* which still adheres to some points of the surface; he has washed the extremity of the coronoid apophysis and a part of the head of the condyle. There one perceives that the brown tint which the whole bone presents has not penetrated deeply. Gravel-stones washed with care have presented a similar peculiarity. The *gangue* conceals some details, especially on the internal side; but it permits, however, a sufficiently complete study. When we examine this jaw, we are at once struck with two peculiarities—the angle formed by the horizontal ramus and the ascending ramus is extremely open; the fourth molar, which alone is in place, is slightly inclined forward. These two traits had been even somewhat exaggerated in a drawing which was first sent to me, and perhaps to this cause is due the attention which from the first they have elicited from me. Should we see there a race-character? Before examining in this point of view, let us remark that for man, as for animals, the comparative osteology of races, in respect to details, is still very little advanced. It is a new study, to which palæontologists are necessarily put as well as anthropologists, by reason of the facts which tend to bring into contact the history of animals and that of man. The obtuseness (*ouverture*) of the angle of which I speak is one of those traits that age and perhaps other circumstances, and, moreover, even individual conditions, cause considerably to vary. Amongst the specimens in the gallery of the Museum, I have found that in one head of an Esquimaux it is perhaps much greater than in the jaw from Abbeville, whilst in another head of the same race it is nearly straight. I have elsewhere found in different races other examples of an angle as obtuse, and of analogous variations. A fresh study and exact measurements taken of many individuals of different ages and races are still necessary.

"Is the inclination of the tooth a race-character? It is easy to answer this question by examining the alveoles of the incisors still intact. These prove a vertical implantation. The inclination of the incisors has certainly nothing different from what we observe in races the most strongly orthognathous. This is a very important fact, for it tends to resolve a contested question. Some anthropologists, amongst whom are men that I respect equally for their judgment and science, have thought that the negros—that is to say, races essentially prognathic—should be nearer the primitive type of humanity, and that the superior races have taken their birth through a progressive development; that they are, in consequence, posterior to the negro. Now in 1861, in my lectures at the Museum, I laboured to show that present science furnished but few facts, and those vague and conjectural, on the characters possessed by primitive man; but that it permitted us to specify, almost with certainty, some of those which he did not possess. In dwelling upon the phenomena of Atavism, and on the principles of philology, I believed I was able to affirm that the negro race was not the first to appear; that the white, however high he might carry back his genealogy, would never find the negro amongst his ancestors. The orthognathism of the Abbeville fossil adds one argument to, and more serious than those which I had then estimated. The man to whom this jaw belonged was the contemporary of elephants and rhinoceroses which have become extinct, if we may admit the opinion of many eminent geologists. In any case, it remains at present the representative of the most ancient races known; and nothing in the disposition of his teeth indicates that prognathism which is the essential character of all the negro races, and which they transmit in inter-breeds with such great persistence.

"I believe myself, then, more and more authorized to repeat, that the negro and the white represent the extreme modifications of a primitive type which was placed somewhere between the two. As to the inclination of the molar in the Abbeville fossil, there is certainly nothing characteristic in it. On the one hand, I have found analogous facts in many heads of different races in the collections of the Museum. On the other hand, the inclination appears to me to be here the result of an accident. The molar placed in front of that which remains had fallen out while the individual was living. The alveolus has been filled up by the process of ossification which takes place in that case. One comprehends that, before this filling in, the tooth placed behind the void could be pushed or drawn easily in the direction where it no longer finds the usual support.

"Dr Falconer, with whom I had the advantage of examining the jaw, was forcibly struck with the following peculiarity. The edge of the angle of the jaw and the posterior portion of the inferior border of the horizontal ramus curved slightly inwards. The internal base of the bone presented thus, below the oblique line, a sort of canal, or rather of large gutter, extending as far as the vicinity of the chin, and sensibly more pronounced than it was in a modern jaw placed by a dentist at our service. I have sought in this respect for facts which might be afforded by the gallery of anthropology. I have found very marked traces of inversion inwards of the ngle of the jaw in a Bengalese, a Javanese, and a Bellovacian (Belgian); ndications only in a Laplander, a young negress, and an Egyptian mummy. n opposition to this, an aged Egyptian mummy and a New Caledonian ave exhibited this trait very decidedly, and in a Malay of Batavia it is s marked as in our fossil, or very little less. Thus different human races resent all degrees of this character; but at the same time the inverse haracter presents itself in the majority of individuals of all races.* New omparisons are necessary, without doubt, to appreciate the value and the signification of these characters.

"To what causes belong these contrary dispositions? Without wishing to be too positive, I see in them, at present, the effect of the action of the masseter acting outside, and of the internal pterygoid acting inside. The relative weakness of the latter explains why the masseter ordinarily prevails. Their accidental preponderance would be caused by the habit of *grinding* the food, a habit which persons advanced in age often have. This last observation was made by M. Jacquart, Assistant Naturalist to the Chair of Anthropology. As to the canal or gutter, we only see there an exaggeration of that which exists normally. It is, indeed, at this point that we find the channel designed to contain the submaxillary gland. The inflection of the edge of the bone alone renders it more prominent and deeper. The same *savant* called my attention in a special manner to the form of condyle. The inferior internal border of its head is here, indeed, very little marked. Its head is, moreover, perhaps more rounded and larger outwards than ordinary; but these peculiarities cannot be considered as essential characters. In the same race very great differences may be noticed. In the Tahitians and the New Caledonians the head of the condyle is sometimes nearly triangular, with one of the sides of the triangle placed outwards, and one of the angles inwards. Lastly, may not age here again exercise an influence? I would say as much, from the great opening that the sigmoid *échancrure* presents. We see thus how many studies and comparisons should still be made before pronouncing on the real value of the peculiarities which the Abbeville jaw presents.

"Thanks to M. Lartet, I have been able to compare already this jaw with a median portion of the same bone, found by him in the rubbish (*déblais*) of the cavern of Aurignac, and with the body of the same bone discovered by M. de Vibray, in the cavern of Arcy. M. Pruner-Bey kindly joined M. Lartet in the comparative examination that we made of these precious remains. On all points we concurred in the same opinions.

"In the portions common to them all, these three bones presented slight differences, but also resemblances. Thus the canal or gutter I spoke of just now, was distinguished from that in the Aurignac jaw, as well as from that in the Arcy, inasmuch as it appeared perhaps a little more decided there than the former. . . .

"In respect to the Abbeville jaw, it appears to all three of us to be very probably that of an aged individual, and in any case, of small size, or approaching, at most, middle stature.

"I will add, that in this jaw there is absolutely nothing that supports the ideas entertained by some adventurous minds, who make out man to be descended from the ape by means of successive modifications. This jaw is somewhat more feeble than strong; altogether characteristic of man; and it has nothing of the *ferocious physiognomy*, if I may be permitted the expression, that is sometimes displayed in the same part of the skeleton in existing races.

* Dr. Falconer came independently to the same conclusions.

"In conclusion, we may readily observe in the lower jaws of individuals of our own time differences as much, and more, marked than any of those which distinguish the Abbeville jaw from many of the jaws in the Museum collections. In other words, these differences, in every respect, are within the *limits of variation* in existing races."

At the opening meeting of the Anthropological Society, on the 22nd February last, Mr. Mackie commented in strong terms on the evidence of the geological human remains, pointing out that the Engis and other oldest fossil skulls indicated a higher grade of man than one would expect as a link of the human race with the gorilla; and that, moreover, the geological evidence, truly put, showed primitive man as an intellectual, though it might be as the flint-implements indicated, a very inexperienced and untutored being; whilst of the gorilla, which the transmutationists admit to be man's nearest link with the brutes, not a single fragment had been found. Stating, however, his belief in the unity of Creation, he said he thought that if the link between man and the inferior animals were ever traced, it would be found to be short and sudden—at most a thread-like line of strongly variable descent, rather than a general gradual improvement of any breed of apes, as is supposed by the Darwinian hypothesis of a transmutation of species.

It is to be regretted that the Society's report of this meeting, published in the Anthropological Journal, does not record what he said, but, in a short and incorrect paragraph, attributes words to him he never spoke.

It is not a little singular that within a month the evidence from the Abbeville gravels should add direct testimony to this opinion.

At the sitting of the Paris Academy, on the 18th ultimo, M. Milne-Edwards gave an account of the proceedings of the commission at Abbeville. The 'Institut' adds: "The jaw exhibited before the Academy, the flint-implements which accompanied it, have been truly found in the bed *called* diluvial, at Moulin-Quignon, near Abbeville. We purposely say, in the bed called diluvial, for although all controversy has ceased in respect to the discovery, many geologists, at the head of whom is M. Elie de Beaumont, contest the diluvial nature of the deposit in which the discovery has been made. M. Elie de Beaumont declared in a very explicit manner, after having heard the reports of M. Milne-Edwards and of M. de Quatrefages, that according to his opinion the deposit at Moulin-Quignon is not *Diluvium* but a deposit belonging to the formation which he designated a long time ago as the 'terrain meuble des pentes,' that is, a kind of *Post-Diluvium* formed not by marine nor fluviatile alluvia, but by simple weather-action, and much later, or posterior, to the alluvia known by the term Diluvium. The human jaw, the object of so much study, would lose, then, in losing its antiquity, a great part of the importance that it would have had if the deposit was indisputably recognized as being diluvial; for, according to M. Elie de Beaumont, it is a simple relic of the period known as the stone-age, and the antiquity of which does not go further back than 3000 or 4000 years." This idea, however, remains to be proved; or, at least, after Mr. Prestwich's account of the district, it is necessary should have the geological evidence put before us before we accept this conclusion.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

GEOLOGICAL SOCIETY.—*April* 1.—The Rev. Dr. O. Heer, Professor of Botany in the University of Zurich; Signor P. Savi, Professor of Geology in the University of Pisa; Signor G. Ponzi, Professor of Comparative Anatomy and Physiology in the University of Rome; Dr. J. Leidy, Professor of Anatomy in the University of Pennsylvania; Il Marchese Pareto, of Genoa; and Professor A. Daubrée, of the Jardin des Plantes, Paris, were elected Foreign Correspondents.

The following communication was read:—"On recent Changes in the Delta of the Ganges." By James Fergusson, Esq., F.R.G.S.

Before describing the local phenomena of the Ganges, the author explained, first, the laws that govern the extent of the oscillations in reaches of rivers, either laterally or in the direction of their course; secondly, the causes operating to raise the banks of rivers flowing through very flat plains above the level of the country at a little distance from their margins; and lastly, the immense relative thickness of the early deposits in deltas over those of later periods, when the conditions of the river had come more nearly *in æquilibrium*.

Mr. Fergusson then proceeded to point out that in historical times the Brahmapootra and Ganges, on entering the plains of Bengal,—passing Goalparah and Rajmahal respectively,—ran originally to the sea in a nearly due north and south course, parallel to one another. This symmetry was first disturbed by the upheaval of the Modopore jungle, north of Dacca, by which the Brahmapootra was diverted in a south-eastern direction into the depression known as the Sylhet Jheels, which were the result of the upheaval just described. He then further explained how the river, having filled up these Jheels, had returned to its former bed within the limits of the present century.

The paper then described the effect this change had already produced in reopening the rivers of the western half of the delta, and showed that, if it were maintained, it would have the effect of so raising the eastern half as to restore the course of the two great rivers very nearly to the position they occupied before the disturbance above alluded to.

The next point adverted to was the gradual retrocession of all the mouths of the tributaries of the Ganges, in consequence of the tilting back of the plain, by the gradual rise of the deltaic plains.

Mr. Fergusson then stated that he conceived we had sufficient historical indications to show that within the last 5000 years the plain of Bengal has been nearly in the same condition that the valley at Assam now is,—a jungly swamp, with only a few habitable spots here and there on the banks of the larger rivers.

The last phenomenon alluded to was the "swatch of low ground" in the Bay of Bengal. This was ascribed to the action of the tides, which, being accelerated on either shore of the bay, acquired a rotatory motion at the sand-heads, and, meeting in the centre of the bay, scooped or swept out this depression in the centre, and by this action prevented the growth of the delta seaward to the extent that would otherwise take place.

April 22*nd*.—1. "On the Gneiss and other Azoic Rocks, and on the superjacent Palæozoic Formations of Bavaria and Bohemia." By Sir R. I. Murchison, K.C.B.

The recent important discovery by M. Gümbel of a representative, near Hof, of the primordial zone of the Silurian basin of Prague, induced the author to obtain some further particulars regarding the older rocks of Bavaria and Bohemia; and a large part of this communication referred to the sketch-map and section supplied to him by that gentleman.

One of Sir Roderick's principal objects in exploring this region was to convince himself, if possible, of the existence of a fundamental gneiss of as high antiquity as the Laurentian rocks of Canada and Scotland, and of the truth of M. Gümbel's view of the distinction of the gneiss into older and younger; but, after a survey of the whole district, he was unable to distinguish any order of superposition between its two members, the so-called younger gneiss, in one extensive tract near the Danube, dipping, according to M. Gümbel, under the older; and their variable strike rendered it as difficult to judge by that character as by their dip, its direction in some places being at right angles to what it is in others. For the present, therefore, though with the greatest respect for the labours of M. Gümbel, he considers the gneiss-rocks to constitute one great series, it being certain that the two varieties are not separated by any different intervening sediment, as in the north-west of Scotland.

A clear illustration of the whole ascending succession is afforded by the order of superposition exhibited in M. Gümbel's section from Hof to Selb, a distance of about seven or eight miles. Gneiss is there seen resting against granite, and passing up into mica-slate underlying concretionary, quartzose, chloritic masses, which form the base of the Urthonschiefer. This primary clay-slate is followed by quartzites and black roofing-slate, in the latter of which the fossils of the Silurian primordial zone of Barrande occur, and ultimately by other Silurian, Devonian, and Lower Carboniferous strata in conformable succession, the latter passing conformably upwards into mountain limestone, which is shown to be quite unconformable to the Upper Carboniferous of Germany. In the remaining north-west portion of the section the strata are repeated in inverted succession, having been dislocated by the intrusion of igneous rocks.

Sir Roderick next adverted to the question of the parallelism of the Silurian rocks of Bohemia with those of Britain, pointing out that the Austrian Geological Survey, whose new map he exhibited, had adopted, for this occasion only, the colours used by the Geological Survey of Great Britain; and he stated his belief that too close a parallelism between the subformations had been attempted, and that the parallelism of such large groups only as Lower and Upper Silurian, as proposed by Barrande, with a possible interpolation of "Middle Silurian," could be maintained.

The author then contrasted the absence of Devonian and Lower Carboniferous rocks, coupled with the full development of Lower and Upper Silurian life, in Bohemia with the fuller and unbroken succession in Bavaria. He concluded by observing that the conformable succession of strata in Bavaria and other tracts shows the existence of beds which bridge over the gaps, represented by unconformities, that occur in the British series; and pointedly adverted to the two facts, that the enormous thickness of clay-slate beneath the primordial zone, though unaltered over large areas, had afforded no vestiges of life, and that the transitional groups of strata uniting two great systems had not afforded in any country a link connecting one class of animals with another.

2. "Notice of a Section at Mocktree." By R. Lightbody, Esq.

The lower portion of this section was stated to exhibit the Aymestry limestone, with its characteristic honeycomb structure, and showing at its upper limit a basin-shaped depression containing beds of sandy clay deposited parallel to its sides, and unconformable to the Aymestry limestone, though at a little distance from the trough this unconformity disappears. These argillaceous beds contain Lower Ludlow fossils, though they overlie the Aymestry limestone; the author consequently proposes that the latter term should no longer be used as a separate subdivision. He also remarked that, in consequence of a fault bringing the Upper and Lower Ludlow beds against one another, without having altered their dip, many fossils have been stated to occur in the Upper Ludlow which really belong to the Lower.

The following specimens were exhibited:—

A specimen of *Calais Newboldii*, a new Octopod, from Mount Lebanon, by J. de C. Sowerby, Esq. Palatal Teeth of *Cochliodus*, from the Carboniferous limestone, by the Earl of Enniskillen.

May 6th.—1. "On the Brick-pit at Lexden, near Colchester." By the Rev. Osmond Fisher, M.A., F.G.S.; with a note on the *Coleoptera*, by T. V. Wollaston, Esq., F.L.S.

Lexden is a village about a mile west of Colchester, and is situated on a plateau on the south side of the Valley of the Colne. The brick-pit shows this table-land to consist of thick beds of gravel and sand, resting upon the London Clay, and containing at its southern extremity a talus of old gravel. This stratified gravel is overlaid by brick-earth and soil, and is believed by the author to be that which elsewhere underlies the Boulder-clay; and he states that between it and the brick-earth there is, in one locality, a layer of peat containing bones of *Elephas primigenius*, and the remains of many insects; the latter are considered by Mr. Wollaston to differ from British recent species, and to indicate a warmer climate than now obtains in the district.

2. "On the original nature and subsequent alteration of Mica Schist." By H. C. Sorby, Esq., F.R.S., F.G.S.

When ripples are formed whilst material is being deposited, there is a structure generated which the author has, in former papers, termed "ripple-drift," and which he now described. This structure he stated might frequently be seen in polished sections of clay-slates, and also, in a form modified through metamorphism, in many mica-schists. From a consideration of the facts revealed by an examination of those rocks, he concluded that mica-schist is of sedimentary origin, metamorphosed after deposition, and sometimes after the production of cleavage and other physical changes; and that the bands of different minerals represent the planes of original deposition.

3. "On the Fossil Corals of the West Indies."—Part I. By P. Martin Duncan, Esq., F.G.S.

The paucity of information concerning the Geology and Palæontology of the West Indies, and the deficiency of carefully described species of recent corals, were stated to have involved this subject in great obscurity. Dr. Duncan, however, remarked that the paper by Dr. Nugent, published more than forty years ago, showed the existence in Antigua of three consecutive Coral-formations, called by him (in ascending order)—1, the inclined strata; 2, the chert; 3, the marl.

After describing in detail the seventy species and varieties of Fossil Corals from the West Indian Islands which he had been able to determine, Dr. Duncan exhibited in the form of tables the relation which this fossil fauna bears to the existing fauna of the Caribbean Sea, and to that of the Pacific, South Sea, and Indian Ocean, showing that it is more nearly related to the latter than to the former. He also showed that it bears a closer relation to the European Miocene coral-fauna than to the recent West Indian; and he therefore considered it to be most probably of Miocene age. The author concluded by describing what he believed to be the chief features of the physical geography of the Miocene period, substituting a series of Archipelagos for the Atlantis of Professor Heer, and stating that the Pacific Ocean must have been at that period in immediate connection with the Caribbean Sea.

A portion of the skull of *Mastodon latidens*, from Perim Island, in the Gulf of Cambay, was exhibited by C. S. Mann, Esq.

Civil Engineers.—*March* 3.—"On the Perennial and Flood Waters of the Upper Thames," by the Rev. J. C. Clutterbuck, M.A.

The object of this communication was to draw attention to the nature of that portion of the watershed of the Thames comprising the oolitic district, and containing a computated area of 1500 square miles, situated between the range of chalk hills bounding the vales of Aylesbury and of White Horse, and the Cotswold Hills bounding the Vale of Evesham and the Valley of the Severn. It was shown that the Thames ran almost entirely over a clay-bed from its source, about four miles west of Cirencester, to its junction with the Thame stream, the limit of the district under consideration; and that it was the mere carrier of waters, whether perennial or flood, brought in by its tributaries, a description of which, in the order they joined the main river, was given. Those running from north to south and from north-west to south-east,—as the Churn, the Coln, the Leach, the Windrush, the Evenlode, and the Cherwell,—received their perennial waters from oolitic strata. Those flowing from south to north originated in the the chalk hills, from the escarpment of which they conveyed the back drainage, slightly augmented by that of the Upper Greensand, and then passed over the Gault and Kimmeridge clays, either to the main stream, as the Ray and the Cole, or as affluents of the Ock and the Thame, from which the principal supply was derived.

The geological condition of the source of the main stream was next noticed, and it was stated that the whole natural bed of the river, from Somerford Keynes to Sandford, below Oxford, was an excavation in the Oxford clay, flanked to the south by the escarpment of the coraline oolite, which rested on a ridge of the clay. As a rule, the lower levels of the valley, including also in many places the oolitic rock, outcropping to the north at a very slight angle beneath the Oxford clay, were covered with drift gravel. Wherever the floods had extended, sand, silt, or argillaceous loam had been deposited on this gravel; and this action was still going on, governed by the number and character of the floods. Thus, the bed of the river was, as a rule, gravel, and the banks a warp, the accumulation of ages. There were instances of the change of bed to the extent of several chains in width; and indeed there appeared to be no limit to these deviations, but the physical features of the valley. These facts had an important bearing on any improvement, so much needed, in the drainage or condition of the Thames valley.

The perennial waters were either used for mills or for navigation. The mills on the tributaries were numerous. Between Thames Head and Cricklade they were, however, virtually deprived of water. From Cricklade to Lechlade the water was not applied to any economical use; and again, from Lechlade to Wolvercote, three miles above Oxford, there were no mills. The gaugings of the numerous tributaries, where they joined the main stream, would give the aggregate of the water that it carried; but such observations had been neglected, and as the watersheds were very varied, any estimate of the volume of these streams at different seasons would be difficult. Most of these tributaries were immediately affected by heavy rains, and were subject to flood. The gauging of the main stream was beset with other difficulties, as the height and passage of the water was divided between the mills and the navigation, controlled, indeed, by stringent regulations, but too often disregarded. Though it was not the purpose of this communication to deal with absolute quantities derived from the various sources, yet it was believed the following gaugings, the result of several years' observations, by Mr. Stacy, the manager of the mills at Wolvercote, would be received with interest, and would, if carried out in other places, lead to valuable results. There were no mills for thirty miles above Wolvercote, and the navigation, though "flashes" were still sent down, had virtually ceased. Mr. Stacy had found that, in the summer months, the river had a mean velocity of 58 feet per minute, when the total yield was 8120 cubic feet per minute, exclusive of the quantity brought down by "flashes," which it was difficult to estimate. During the winter months, in fine weather, without frost or rain, the river had a mean velocity of 94·9 feet per minute, and taking the sectional area as 181·5 square feet, this gave a volume of 17,224 cubic feet per minute. In moderate rainy weather, without floods, when the level of the river just reached the high-water navigation mark, the total quantity of water passing through the mill was 28,189 cubic feet per minute. At the end of December, 1862, under similar conditions, the total yield was 35,498 cubic feet per minute, of which 7738 cubic feet might be taken as the water passing from the main stream to Wytham. These data suggested the necessity of adopting a standard at various stations, so that the results might be compared with the rainfall when the gaugings were taken. At the same time, observations were made on the river below the influx of the Cherwell and the Ock, when the yield was found to be 50,995 cubic feet per minute, being an excess of 15,497 cubic feet as compared with Wolvercote, and of which excess it was estimated that 7689 cubic feet were brought in by the Cherwell, and the remainder by the Ock and the smaller perennial streams. The verification of these quantities was prevented by a fall of rain of nearly half an inch, in a few hours, which, at the expiration of thirty-six hours, doubled the volume of the Thame stream, and added about thirty per cent. to the volume of the main river. At Wolvercote, on the 5th of January, 1863, after about one inch of rain, the increase was from 27,986 to 48,418 cubic feet per minute. The rainfall from the 1st to the 7th January, 1863, inclusive, produced a flood in the Thames under circumstances peculiarly favourable for observation. The rain recorded during this period averaged 1·61 inch over the whole watershed; Dalton's gauge, at Hemel Hempstead, showing a fall of 1·52 inch, and a percolation of 1·10 inch. The gaugings of the main river at Wolvercote then amounted to 82,500 cubic feet per minute, and at Clifton Hampden, below Abingdon, to 181,832 cubic feet per minute. Of this latter quantity 44,755 cubic feet were delivered by the Cherwell (or an increase of 37,066 cubic feet as due to the flood), 24,864 cubic feet by the Ock, and 29,713 cubic feet by the many smaller streams, watercourses, and land-drainage outfalls, issuing into the river between Wolvercote and Clifton Hampden, a distance of about twenty miles by the river, with an average fall of two feet per mile, from a computed watershed of eighty square miles. It should be stated that the rainfall on this occasion, on the southern part of the district, was in excess of the average more than half an inch.

The state of the navigation between Lechlade and Oxford was then described. It was remarked that from running on one stratum, the Oxford clay, and from other causes, it had ceased to be; although the physical condition of the river bed, and its easy gradients, offered facilities for navigation; for the whole fall in this distance, 31 miles, was only 51 feet 3 inches, or about 1 foot $7\frac{1}{2}$ inches on an average per mile.

The highest recorded floods on the Thames, since January 8, 1734, were then alluded to, and details were given of that which occurred March 29-31, 1862. The action of land-drainage on flood-water was next considered. It was generally admitted that the floods in the main river and its tributaries rose more rapidly than formerly; there being in some localities an advance of twenty-four in seventy-two hours within the last twenty years. There was a difference of opinion as to the subsidence of the water. As yet, however, it was believed, that land-drainage had produced little apparent practical effect on the volume of the flood, or perennial waters of the Upper Thames.

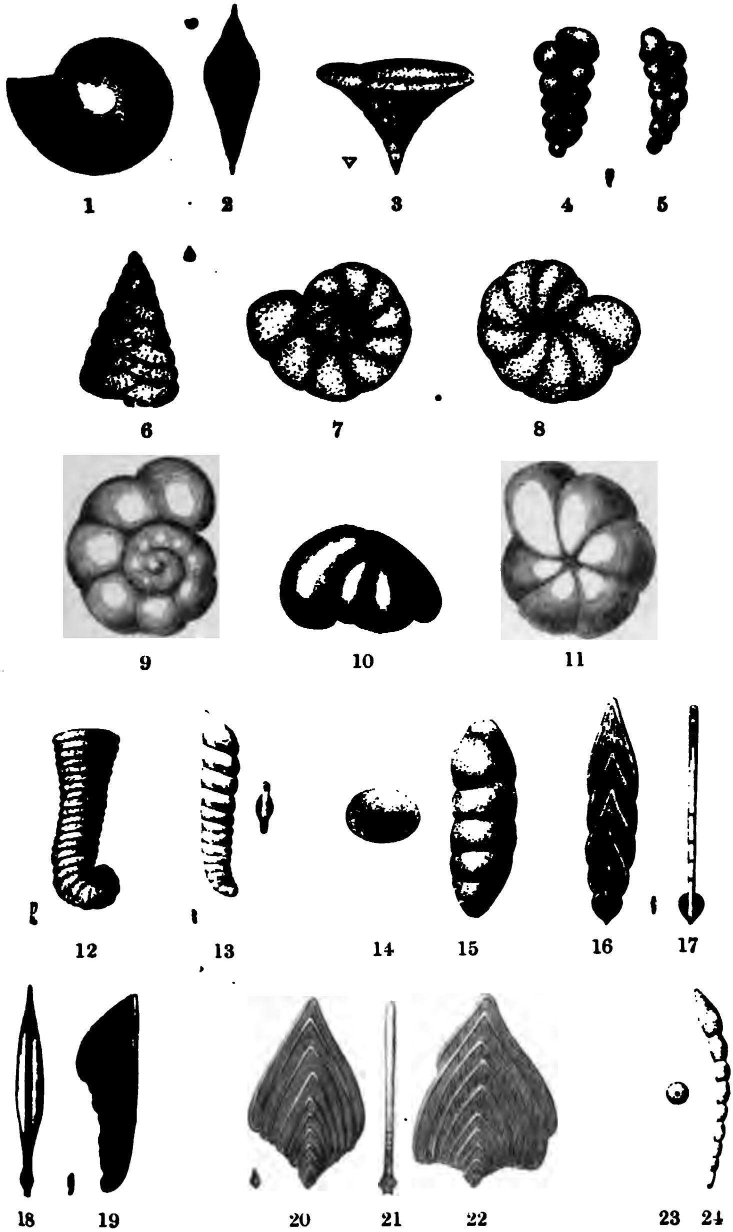
There was great scope for improvement in the valleys of the Thames and its tributaries, especially the Thame, the Ock, the Cherwell, and the Evenlode. With a view to prevent injury by floods, Mr. Bryan Wood had successfully carried out several important works, based on a system in which the local drainage was separated from the flood. If, by some such plan, the floods were brought under control, and the water prevented from remaining stagnant on the land, property would be improved, and the sanitary condition of the Valley of the Upper Thames would be greatly benefited.

NOTES AND QUERIES.

Foraminifera of the Chalk.—At one time I paid considerable attention to the microscopic organisms of the Chalk, and those met with on the bands of flint-nodules, with the hope that I might be able to distinguish the various strata of the Upper Cretaceous deposits by this means. I cannot say the result was as successful as I could have wished. The white and grey chalks seemed characterized by sufficiently marked distinctions, but the main object I had in view was, if possible, to be able to distinguish one stratum of white chalk from another. Along a wide expanse of cliff, like that of Dover, Brighton, or Flamborough Head, it is easy enough, or rather it is practicable, to make out each bed definitely; but in collecting fossils from inland quarries, it is not so easy, and in fact is very often impracticable to make out the exact stratum exposed. It occurred to me then that microscopic characters might aid towards a conclusion, if they would not positively decide; and still entertaining this view, although to a greatly modified extent, I should be glad to learn the results of any microscopic investigations which any of the numerous readers of this magazine may have made.—Ed. Geol.

Deptford Gravel.—The low-level sewer now in course of construction at Deptford is excavated between the creek and the main street, in a deep bed of gravel, the spoil of which is now lying in heaps favourable for investigation. No worked flints have turned up. Fragments of elephant tooth, and a whole tooth of rhinoceros (?) are the whole of the foreign contents, with the exception of some broken pottery of modern origin, and the singular occurrence of a few copper coins lying in apparently undisturbed gravel 35 feet from the surface. The gravel abounds in the usual flint fossils, and some fragments of the lower beds underneath have been extracted, consisting of compact green sandy marl. The highly intelligent manager of the works showed me the small museum of these curiosities in the counting-house of the works.—S. R. P.

[Halfpence are by no means reliable evidence; they are singularly enough found in many singular places. Workmen leaving their jackets whilst at work is a common source of their being lost about. It would be well for our contributor to state whether he saw these halfpence actually embedded, or only heard so; also, what their dates. If they fell out of workmen's clothes, as we presume they must have done, it is not at al



FORAMINIFERA FROM THE CHALK OF KENT.

S. J. Mackie del.

roba... ey might be arrested and held in a chink or cavity in the gravel. As our respondent's notice now reads, he would seem to state they were solidly embedded in matrix of the gravel at a depth of thirty-five feet, a by no means likely occurrence.— GEOL.]

'RODUCTION OF COPPER.—The following extracts are from the 'Lake perior Miner:'—

'In 1830, the total production of the copper mines of the world was ut 25,500 tons of metal, and of this amount Great Britain produced 200, or more than 50 per cent. of the whole, while the United States Canada furnished but 50 tons, or two-tenths of 1 per cent. The Russian pire then produced nearly 4000 tons, the Austrian Empire 2150 tons, whole of Asia some 2500 tons. In 1853, twenty-three years later, tain had only increased her annual product to 14,500 tons, her pertage of the whole amount receding to 26; while Chili, in South Ame-, which in 1830 only yielded 200 tons, had raised her product to 14,000 s, or over 25 per cent. of the total production. From that period for-'d to the present time, the copper production of the Chilian mines we eve, exceeded those of any other country, the value of their exports in t metal alone amounting to $10,760,000 in 1857, while the value of tish mine products for the same year was worth about $9,500,000. Russians had increased the yield of their mines to 6,500 tons, or 11¾ cent. of the whole; the Austrians to 3300 tons, or 6 per cent.; the ole of Asia only 3000 tons, or 5½ per cent.; while the United States Canadas raised that year 2000 tons, over 3⅓ per cent. of the total prots for that year, which were about 55,700 tons; Australia and New land produced about 3000 tons; Cuba, 350 tons; Scandinavia, 2000 s; the German States, 1450 tons; and the rest of Europe, exclusive of countries above named, 1000 tons.

During the past ten years, the mines of Lake Superior have probably eased their production more rapidly than those of any other country, exports for 1861—7500 tons of metal—being about twelve times greater n those of 1851. That our ratio of increase in the coming ten years l be as great should not probably be expected, as that would amount to 00 tons; more by at least 40 per cent. than the present product of the ld's mines. Of the 80 miles of copper range east of us, and 40 to 50 es west, comparatively few mining properties have yet been explored."

USEFULNESS OF DIAMONDS.—Many persons suppose that diamonds are y used as jewellery,—for rings and other articles of personal adornment, nd that they are really of no essential value whatever in the practical arts. s is a mistaken notion; they are used for a great number of purposes in arts. Thus, for cutting the glass of our windows into proper sizes, no er substance can equal it, and it is exclusively used for this purpose. atural edge, or point, as it is called, is used for this work, and thousands annually required in our glass factories. Diamond-points are also ployed for engraving on carnelians, amethysts, and other brilliants, and the finer cuttings on cameos and seals. Being very hard, the diamond also used in chronometers for the steps of pivots; and as it possesses h refractive power and little longitudinal aberration, it has been successy employed for the small deep lenses of single microscopes. The magying power of the diamond in proportion to that of plate glass, ground a similar form, is as eight to three. For drawing minute lines on hard el and glass, to make micrometers, there is no substitute for the diamond nt. The rough diamond is called "bort," and the "points" used for glass ting are fragments of the borts. Great care and skill are necessary in ecting the cutting-points, because the diamond that cuts the glass most successfully has the cutting-edges of the crystal placed at right angles to each other, and passing through a point of intersection made by crossing the edges. A polished diamond, however perfect may be its edges, when pressed upon the surface of the glass, splinters it with the slightest of pressure; but with the natural diamond the most accurate lines are produced on glass, and their surfaces are so finely burnished that if, ruled close together, they decompose light and afford the most beautiful prismatic effect, —all the colours of the rainbow flash from them as from the silvery interior of a pearl-oyster shell. Diamonds are also employed as drill-points to perforate rubies, and bore holes in draw-plates for fine wire, and also for drilling in hard steel. Some inquiries have been made recently in regard to using them as a substitute for steel picks in dressing millstones. We apprehend that they are altogether too expensive for this purpose at present; but if some of our inventors would make the discovery of manufacturing diamonds as cheaply as we make charcoal, which is of the same composition, we might be able to recommend them to our millers. The coke obtained from the interior of gas retorts, in many cases, is found so hard that it will cut glass; but as its point endures but for a short period, it cannot be made available as a substitute for the natural diamond for such purposes in the arts. A circle of rough diamonds has lately been used on a hollow cylindrical auger for boring into hard rocks.

MAMMALIAN REMAINS.—Bones of the following Mammalia were recorded by M. Torchi in a letter read before the French Geological Society, 6th April, 1846 (Bull. Géol. Soc. Fr. vol. iii. p. 440–442), found in different strata of the sub-Apennine deposit at Imola, in Romania. *Elephant* found at Ruisseau de Bergullo in "sable quarzeuso-calcaire conchylifère" (marine shells); *Elephas primigenius*, Ruisseau Pratella, in "terrain quarzeuso-calcaire; *Elephant*, Vallée delle Grazie, Ruisseau Pratella, Ruisseau Bergullo, in the same sand; *Rhinoceros*, Ruisseau Pratella, in the same sand; *Hippopotamus*, Ruisseau Pratella, Ruisseau delle Grazie, in the "dernière assise de la Marne fleuve," sub-Apennine; *Equus*, Ruisseau Pratella; *Cervus*, Mont Castellano, Ruisseau Pratella, Fleuve Santerno, in the sand; *Ruminant; Volatile*, Ruisseau de Goccianello, Ruisseau Pratella, in the sand.—S. J. M.

NEBRASKA SALT BASINS.—About 50 miles west of the Missouri river there is a remarkable salt region covering about 1500 acres. It consists of four basins depressed several feet below the common level. The bottoms of the basins are composed of black mud covered over in warm dry weather with a thin stratum of salt, causing them to look like fields of snow. The salt is collected in scrapers, and occasionally a man will scrape up a waggon-load a day. In and about all those basins there are numerous strong brine springs, and farmers come from miles around to boil and scrape salt for their use. It is of excellent quality, and the crystals are large and clear, like those of the solar salt of Syracuse, New York.

NUTS OF CORYLACEÆ, ISLE OF WIGHT.—In the 'Enumeratio Rerum Naturalium quæ in Musæo Zannichelliano asservantur,' Venetiis, 1736, is the following entry:—

"Tabula quinta. 14. Nuces Corylaceæ effossæ in insula Vecti, Angliæ."

The same entry occurs also in the earlier catalogue of Zannichelli's collection, entitled 'Ex Naturæ Gazophylacio penes Joannem Hieronymum Zannichelli.' Venetiis, 1726.—S. J. MACKIE.

REVIEWS.

The Physical Geology and Geography of Great Britain. By Professor A. C. Ramsay, F.R.S. London: Stanford. 1863.

This little book, by the Local Director of the Geological Survey of Great Britain, and President of the Geological Society of London, is founded on a course of six lectures that were delivered to working men in the Museum of Practical Geology in January and February of this year, and seemingly published immediately after their close. This would lead one to suspect they were intended to be the vehicle of some special views at a particular moment, just as Professor Huxley has turned his similar lectures to a purpose suited to the advance of his school. Such, however, we cannot make out to be the case, unless the object of Professor Ramsay was to make an opportunity for asserting that having handled stones for five-and-twenty years, he knew a chipped flint when he saw it (p. 111). Unless this is so, or we have in our obtuseness missed the points of prominent novelty, the three little letters which represent the commercial value of all labours would appear to be the motive for sending out to the world lectures of the most elementary character.

They open pleasantly enough with a reference to the good old days, when those who thought upon the matter at all were content to accept the world as it is, and to believe it always was so. The inquisitiveness of the present age has made man, however, a more restless animal than he was a century ago, and instead of being a kind of perambulating vegetable in a limited locality, he travels by pent-up clouds with the speed of the hurricane, and writes letters and draws portraits with lightning a hundred miles away. Men are not now content to take things as they are, but are intent on knowing what they have come from. Even the working man takes an interest in knowing the history of the soil his spade turns over, and the rock his pick brings down. The lime-burner finds shells in his chalk, and asks how they got there; the road-mender sees fish-scales and sponges in his flints, and inquires what was their origin. "Experience tells us," says Professor Ramsay, "that at these courses of lectures a number of my friends come to see me again and again, and that also there are many new faces present;" and for this reason he finds it necessary, while bound to teach the rudiments of our science, to vary his subjects as much as possible.

The first lecture is on Classification and Denudation; the second on the Physical Structure of Scotland, chiefly dealing with contortion of strata and metamorphism. In it the author tells the old story of a red-hot globe, and a boiling sea, and a primitive crust of granite, in a manner worthy of a Plutonist a hundred years ago, and then admits that subsequent research has shown that this theory will not hold, for, amongst other reasons, there are gneissic rocks of almost all ages in the geological scale. Abandoning then the terms 'igneous' and 'primitive' for granitic and gneissic rocks, and retaining the term 'primary,' is there not an inconsistency? Still more, is not the abandoning the term 'igneous' a fatal concession for the internal heat and gradual cooling down doctrines to which geologists, and the Professor amongst them, still cling like drowning men to straws? Nor is Professor Ramsay's explanation very intelligible or very logical, to our mind. "Now," says he, "I must briefly endeavour to give you an idea of the theory of metamorphism. The simplest kind is of the nature which I hinted at in the last lecture, namely, when an igneous comes into contact with a stratified rock, and when having remained for a long time in a melted state, an alteration in the stratified rock in immediate contact with it takes place." Now rocks do not meet as friends do in walking about the earth, the superior and subjacent rock must, we apprehend, be in immediate contact, at any rate since the first deposit of the latter; and therefore if granite be an igneous rock or fire-heated rock, must not the sedimentary rock have been deposited originally upon it, if it be right to say one rock of one kind of formation is changed by coming into contact with another rock of another kind of formation? We know, of course, the popular notions, but we expect from a geologist in Professor Ramsay's position something more than a parrot-like repetition of popular notions. Such a book as the present, however admirable it may be as an elementary introduction to a deep and attractive science,—and this merit we freely and willingly accord it,—would be unworthy of the author, and his rank as a geologist, and his standing in society, unless it were the vehicle of higher instruction than could be given by a college youth fresh from his class. Elementary treatises we do not expect—unless of more voluminous character, like Lyell's, Delabeche's, Phillips's, or Mantell's—from a *savant* of eminence; and such small essays as the present are rather the class to expect from young men coming into notoriety than those older men who have acquired fame, and from whom we expect, especially when they are in the national service, higher and far more responsible works. Why time should not permit the Professor from showing *how* heat "sometimes eats (*sic*) its way towards the surface in a manner not immediately connected with volcanic action;" why, for his own part, he should believe, and yet leave unexplained his belief, that in one sense granite is an igneous, and in another sense a metamorphic rock; why fusion by heat is necessary for the softening of the rock and the movements of the constituent particles in the act of crystallization; why he should forbear at present from entering on the theory of the essential presence of highly heated water in the formation of granite, as being foreign to the object of his lecture,—are matters of regret, for their subjects are points of very great interest, and properly dealt with would have given high charms to this rudimentary production. But he has preferred to hide his light under a bushel, and to leave the world in darkness. Altogether, metamorphism is, to our minds, so treated with such a want of logic, and such a muddle of facts, and forgetfulness or neglect of recent researches, that it would have been far better for geological science, if not for the author's reputation, that this portion had been eliminated. The third lecture is on the Physical Structure of England, and deals concisely with the various stratified formations, taking up, amongst other topics, the relationship between disturbance and form of country, the effects of disturbance, and denudation. The fourth treats of the distribution of the Miocene and Pliocene Tertiary Strata, Glacial Phenomena, and Origin of certain Lakes, – the glacial epoch, illustrated by glacier and other existing ice phenomena, being treated in a remarkably simple and explanatory manner, and thoroughly worthy of any writer; indeed this portion possesses a charming clearness and enthusiasm rarely equalled. The fifth lecture deals still with the newer or Pliocene strata, treating of the denudation of the coasts of Britain, the present British climates and their causes, areas of drainage, river-valleys and their origin, old river-gravels and prehistoric human remains, historical elevation of the country. Upon this latter subject we have also a word of comment to make. It is very easy for geologists to say "heave up the land," but it is as yet rather doubtful whether nature is quite so ready or able to *do it* as geologists are to *suppose* it done to get difficulties out of their way. It is quite possible that many of the so-called "heaves up" of the land may have other explanations than any heaving at all; and without wishing to say there is no such thing as an elevation of the land, we would certainly ask geologists to bear in mind the possibility of there being variations in the level of the sea. The slow change in the direction of the polar axis, and the possibility of alterations of the axis itself, suggest at least two causes which might effect very considerable differences in the bulging of the sphere of waters round our globe; and some such natural and recurring changes as would be thus brought about, seem more likely than so many jumpings up and down of that solid land, which at any rate appears to be very steady just now. Then, what Mr. Geikie, who is referred to on the point, considers as evidence of upheaval within the historical period, Mr. Carruthers looks upon in a very different light.

The sixth and concluding lecture has for its subject the special effects of the Physical Geology of the country on population and industry, a subject of general interest, and although briefly yet clearly treated, the concluding paragraphs deserve quotation.

"It is interesting to go back a little and inquire what may have been the condition of our country when man first set foot upon its surface. We know that these islands of ours have been frequently united to the Continent, and as frequently disunited, partly by elevations and depressions of the land, and to a great extent also by denudations. When the earliest human population reached their plains, they were probably united to the Continent. Such is the deliberate opinion of some of our best geologists. They do not assert it as a positive fact, but they consider it probable that these old prehistoric men inhabited our country along with the great hairy mammoth, the rhinoceros, the cave-bear, the lion, and the hippopotamus; that they travelled westwards from the continent of Europe, along with these extinct mammalia, over that continuation of the land which originally united Great Britain to the Continent. But in later times denudations and alterations of level have taken place, chiefly, I believe, great denudations of the chalk, and of the strata that cover the chalk, and then our island has become disunited from the mainland. And now, with all its numerous inlets, its great extent of coast, its admirable harbours, our country lies within the direct influence of the Gulf stream, which influences the whole climate of the west of Europe; and we, a mixed race of people, Celt, Scandinavian, Saxon, Norman, more or less intermingled in blood, are so happily placed that, in a great measure, we have the command of the commerce of Europe, and send out our fleets of merchandise from every port. We are happy, in my opinion, above all things in this, that by denudation we have been dissevered from the continent of Europe, for thus it happens that, uninfluenced by the immediate contact of hostile countries, and almost unbiassed by the influence of peoples of foreign blood, during the long course of years in which our country has never seen the foot of an invader, we have been enabled so to develope our own ideas of right and wrong, of political freedom and of political morality, that we now stand here, the freest country on the face of the globe, enjoying our privileges under the strongest and freest Government in the living world."

In the objections we have made to certain topics, we have not wished hose objections to stand against the book. They hold, one might say, qually against any other popular book on science at the present time, and ather against geologists generally than books at all. 'The Physical eology and Geography of Great Britain' is a little book deserving of ore than one edition, and will be deserving of very many when Professor amsay gives his mind to the two points we have criticized, especially e first, and rewrites those portions. It will be then a work that will deserve a wide range. We hope to see this done, and Mr. Stanford realize a goodly return from many successive publications.

The Great Stone Book of Nature. By D. T. Ansted, M.A., F.R.S., F.G.S. London and Cambridge: Macmillan and Co. 1863.

The 'Great Stone Book of Nature' would perhaps have been bett called the pretty little book of Geology. What's in a name, indeed? an what's in a title, so long as the owner of the one and the contents of th other are good? We have just reviewed one good little book, and here another. Great men nowadays seem given to little things; and, truly, fro such small seed sown broadcast, we may expect to reap a good crop wh the seed shall have ripened to harvest in the next generation. Pretti Mr. Ansted opens his pretty book. "All know what is meant by the Bo of Nature. But nature is rather a library than a book; for it is the g neral and well-stored receptacle of all that has ever been created, of we know and all we have not yet learned, of all that is animate and that is inanimate, of all that is happening and all that has happened, n only on the earth, but above the earth, and within it and around it. N thing once existing has entirely disappeared. Everything has been phot graphed and is preserved for use and reference somewhere and someho Every year something is discovered that was not before known; but th remains so vast an amount of material yet unknown and unrecorded, th we may be quite sure it will never be exhausted, however long the hum race may remain on the earth, or however highly the faculties of man m be developed." In the river-bed and sea-beach, in the sun, wind, rain, a frost, Mr. Ansted finds the key to the language of the great stone book o the world; he then opens its leaves and shows us the stones of the great stone book. Then he points out the placements and displacements of the stones of the great book, in the brick-pit and gravel-pit, in the quarry, the mine, by volcanos and earthquakes and other disturbances of rocks. Now come the pictures of this great stone book—wonderful pictures, too, they are. Next the treasures,—gems rich and rare, metals precious,—the more really precious the more useful. And so through his brief narration of the world's own special wonders, we are brought to the end of his pretty little book that prettily tells the great story of the Great Stone Book. And Mr. Ansted shuts up his little book, teaching the lesson our young friends will ever learn by an earnest study of the great book itself. "We may never in this life succeed in discovering the whole plan, for it is not likely that finite powers can grasp the Infinite design. But each endeavour that is made humbly and honestly will be productive of good, and the student will rise from the study of any part, either of the work or the method, with wider and clearer views, and be better fitted to perform his other duties and be useful to his fellow-men."

Fig. 1.

Fig. 2.

HYBODUS DUBRISIENSIS, n.s., Mackie.

From the Lower Chalk of Dover (Kent), nat. size.

[In the National Collection, British Museum.]

Fig. 1. Side View. Fig. 2. Base of Lower Jaw, seen from above.

S. J. Mackie del.

THE GEOLOGIST.

JULY 1863.

ON A NEW SPECIES OF HYBODUS FROM THE LOWER CHALK.

BY S. J. MACKIE, F.G.S.

SINCE the publication of Agassiz' 'Poissons Fossiles' only one addition, that we are aware of, has been made to our knowledge of this interesting genus of fishes,—certainly, at least, in respect to British geology. In 1845 Sir Philip Egerton described, before the Geological Society, a large jaw, or rather mouth of teeth, of a fish of this kind, found by Captain Ibbetson in the Isle of Wight, and named by Sir Philip *Hybodus bassanus*.

This species has been assigned to the Lower Greensand, in Morris's Catalogue, but the bed seems, from Sir Philip's statement, to be in a dubious position, for he speaks of it only as "near the junction of the Lower Greensand and Wealden," and says the specimen was sent to him "in the hopes it might tend to show to which of the two formations its bed should be assigned,"—a question he further declines to answer, as "the evidence it affords on this question is neither direct nor conclusive, inasmuch as it is an undescribed species; and consequently any deductions beyond those based upon general affinities would be unwarrantable." Sir Philip adds, however, further on: "The geological inferences afforded by the specimen are briefly told. The species is new. The genus is undoubtedly Hybodus. This genus attains its maximum expansion in the Oolitic series, but it ranges from the Muschelkalk to the Chalk inclusive. The only evidence of its occurrence in the latter formation is a fragment of an ichthyodorulite in the Mantell collection. The teeth have not been found in any strata more recent than the Wealden. As far, therefore, as the evidence goes, it seems much more likely to be of an age anterior to the Cretaceous system." This, then, is at most only doubtfully a Cretaceous species; and the only other instance of which we have any published figure or description is the *Hybodus sulcatus* referred to by Sir Philip, and recorded in Morris's "Catalogue," on the authority of Agassiz (vol. iii. p. 44, t. 106, fig. 15, 16), as from the chalk of Lewes in Sussex. All Agassiz says is, "M. Mantell possesses two fragments of rays of a Hybodus found in the chalk of Lewes, but which are in a bad state of preservation. One recognizes, however, on the surface the furrows and the longitudinal ridges, characteristic of *Hybodus*, which present this particularity, that they are very straight (*droites*) and very uniform. At the posterior edge one distinguishes a well-marked longitudinal ridge (fig. 16*a*), which constitutes a specific character sufficiently defined to permit the founding of a species upon such imperfect pieces. I have not seen any teeth on the posterior sides; I doubt not, however, that such existed, but they have probably been broken, which does not appear astonishing in fragments so damaged." These two fragments, little more than an inch each in length, are now in the British Museum; and a careful inspection has convinced me that grains of Wealden grit still adhere to them, and, therefore, that they can no longer be regarded as even Cretaceous still less as Chalk specimens. No Chalk fossils were ever seen of such a peculiar nature as the substance of which they are composed. There remain, then, to retain *Hybodus* as a Cretaceous species, only those relics, whatever they are, which Professor Morris has recorded as "species: Chalk, Northfleet (Collection Wetherell); Norfolk (*Rose*)," and which have never yet been figured nor described.*

Very great interest, therefore, attached itself at once to a small but very fine and delicately-preserved jaw, with numerous teeth, to which my attention was drawn, in the National Collection (No. 36908). It is from the Lower Chalk of Dover. The extreme length of the right ramus of the lower jaw is 2¼ inches; its vertical depth at the middle and deepest part, ⅝ of an inch; and the depth of the upper and lower jaws together, 1¼ inch. There are twenty-five teeth in all, fully visible, and fragments may be detected of one or two more.

* Mr. Rose informs me that the reference in Morris's Catalogue is to a specimen in his collection identical with the ichthyodorulite figured in Dixon's 'Geology of Sussex,' tab. xxxii. fig. 7, which, however, is not Hybodus. Mr. Rose's specimen is from the Lower Hard Chalk of Whittington, near Stoke Ferry, West Norfolk. What the specimens in Mr. Wetherell's collection are we do not know.—S. J. M.

In all these teeth the central tubercle is much elongated, and in the front teeth assumes a regular tooth-like form, with a less expanded base, apparently only about equal in length to the height of the principal central tubercle. As, however, the teeth recede towards the angle of the jaw, the central tubercle becomes more and more depressed and the base more and more expanded; the central tubercle at last becoming very little elevated, and the lateral denticles very numerous, but with elevations gradually lessening towards the outer ends of the base, in the invariable manner of the teeth of *Hybodus*, and which to us forms the distinguishing feature of the teeth of that genus from the teeth of species of *Cladodus*, in which, on the contrary, the denticles increase in size as they recede from the central tubercle. In all else the two genera seem very closely similar. The teeth of *Acrodus* are also very close in their characters.

In these remarks, it will be seen that we differ from Sir Philip Egerton as to the general uniformity of the teeth of *Hybodus*, and which, on the contrary, we believe varied, as sharks' teeth are well known to do, according to their positions in the jaw. In the specimen we are noticing, from the grey chalk of, probably, Abbot's Cliff, between Dover and Folkestone, this is very prettily shown; and the little group of four or five back teeth (seen in our Fig. 1, Pl. XIII.) exhibit this feature in a remarkable and exquisite manner.

We are inclined, too, to raise a question as to the range in geological time of the genus, at least within the British area. *Hybodus* seems to us to make its first appearance, and in quantity, in the Lias bone-bed. In Morris's "Catalogue" *H. læviusculus*, *H. minor*, and *H. plicatilis* are all referred, with a query, to the Trias,—the first coming from Aust Cliff, the second having the localities Aust and Axmouth, and the last that of Axmouth, recorded, seemingly, on the verbal statement of Sir Philip Egerton. The *H. keuperianus*, entered as from the Keuper of Worcestershire, is evidently the spine of Nemacanthus, an Aust Cliff bone-bed fish.

Of the first, *H. læviusculus*, however, Agassiz, who described it, mentions it as "a very little fragment of a ray of this species in the Museum of Bristol, coming from the Lias of Aust Cliff." Of the second also, he says, "The rays designated under the name of *H. minor*, are really only found in the Lias of the environs of Bristol at Aust Cliff, where we do not find great rays as at Lyme Regis, and they are accompanied in this locality by a kind of teeth very different from those of Dorsetshire." The Muschelkalk, *Hybodus plicatilis*, Agassiz founded on teeth collected by M. d'Alberti from Tæbingen, and some by M. Bronn, from Schwenningen, in Würtemberg. In his notice of this species, Agassiz seems to have imbibed the idea, which Sir Philip Egerton has followed, of there being a great uniformity in the teeth of Hybodus, and upon these grounds excludes from the figures 7 to 18 of Plate 24, which he had assigned to *H. plicatilis*, all but fig. 10 and 13; raising 7, 8, 11, 12, 14, 16, into the species *H. Mougeoti*, and fig. 17 and 18 into *H. polycyphus*, and fig. 9 and 15 into *H. angustus*. These three species, however, unless they have something more definite besides this untenable character of non-variation to depend upon, must hereafter be looked upon as very questionable, as the variation of the teeth in our Chalk specimen must render evident to every unbiassed mind.

The question of the geological age of *H. plicatilis*, must rest on the correctness of the assignment of the so-called Muschelkalk beds of Tæbingen and Schwenningen; but there are, it will be seen further on, other specimens in our National Collection from beds termed Muschelkalk in other Continental localities: and from which, too, *H. obliquus*, *H. rugosus*, and *H. sublævis* are recorded.

Agassiz is certainly wrong in admitting *H. sulcatus* at the recent end of the geological series as a Chalk specimen, and it would be well therefore to examine the right to the antiquity of those species he and others put at the older end of that series. I am not sufficiently acquainted with the Muschelkalk strata to do this myself.

Still, so nearly allied as is the genus *Acrodus*, we may expect, if we believe in development doctrines, a few early preceding forms in an era older than the Jurassic—the period of "reign," *par excellence*, in quantity of individuals and in number of species of the genus Hybodus. The teeth of our Chalk species—the most recent known—are more like those of the Muschelkalk species (*H. plicatilis*) than any other, and a comparison with fig. 1 of Agassiz' Plate 22*a* may well be made. This resemblance is not, perhaps, a little singular; and we have a floating idea—not yet properly worked out by facts—that during the period of extinction of a genus or family, there is a tendency to sportive (?) varieties, and amongst these a greater or less disposition to revert to the originating form. For example, in the Cretaceous era, when the Ammonites died out, we see numbers of forms, Hamites, Crioceras, etc., reverting, as it were, back to the primitive Orthoceras, until in the Baculite of the Upper Chalk, where the chambered-cephalopods—excepting the Nautilus—cease altogether, we have a form straight and conical as that primitive type itself. Perhaps, however, this is but a fanciful idea, and time will not now allow us to work it out.

The species given by Professor Morris are—

From the Chalk (error, should be Wealden, S. J. M.)—*H. sulcatus*; species, chalk, Northfleet (Wetherell Coll.), Norfolk (Rose Coll.); Lower Greensand (? Wealden, S. J. M.), —*H. basanus*; Wealden,—*H. subcarinatus*; Portland,—*H. strictus*; Kimmeridge Clay,—*H. acutus*, *H. leptodus*; Common to both Great Oolite and Wealden,—*H. dubius*, *H. dorsalis* (Hastings), *H. marginalis*, *H. striatulus*; Great Oolite,—*H. apicalis*, *H. grossoconus*, *H. Lawsoni*, *H. obtusus*, *H. polyprion*, *H. undulatus*; Inferior Oolite,—*H. crassus*; Lias,—*H. carinatus*, *H. crassiformis*, *H. curtus*, *H. Delabechei*, *H. ensatus*, *H. formosus*, *H. medius*, *H. pyramidalis*, *H. raricostatus*, *H. reticulatus*; Trias? (Lias Bone-bed, S. J. M.),—*H. laevinoculus*, *H. plicatilis*, *H. minor*; from the Keuper of Worcestershire,—*H. keuperianus*.

The following are the specimens of Hybodus in the British Museum:—Back tooth of *Hybodus polyprion*, Agassiz, from Wealden of Tilgate Forest (Mantell Coll.); back tooth of *Hybodus* (? sp.) from Wealden of Sussex (Dixon Coll.); several front teeth of *Hybodus* (? sp.) from Wealden, Tilgate Forest (Mantell Coll.); front teeth of *Hybodus grossiconus*, Agassiz; Wealden, Tilgate Forest (Dixon Coll.); others of same species, no locality given, but name of "P. Doran" attached to label; two others of same species from Forest Marble of Atford, collected by Mr. Wood; some from the Forest Marble of Stanton, presented by W. Cunnington, Esq.; one from the Forest Marble of Malmesbury, collected by Mr. Buy; one seemingly of the same species from the Great Oolite of Stonesfield; several from the Forest Marble of Wiltshire (W. Cunnington, Esq.); two from Stonesfield Slate of Oxfordshire (Mantell Coll.), several from the Stonesfield Slate of Eyeford, collected by Mr. Binfield. Back teeth of *Hybodus polyprion*, from the Stonesfield Slate of Eyeford (Mr. Binfield); one from Great Oolite of Stonesfield, presented by S. P. Pratt, Esq.; one also apparently of the same species from the Great Oolite of the same locality; two from the Stonesfield Slate of Oxfordshire (Mantell Coll.); three anterior side-(?) teeth, seemingly of this species, from the same formation and district; a posterior (?) side-tooth from Great Oolite of Stonesfield; four largish teeth of a Hybodus, apparently *H. polyprion*, from the Great Oolite of Malton (Bean Collection). Two back teeth of *Hybodus reticulatus*, Agassiz, from the Lias of Lyme Regis; six of *Hybodus pyramidalis*, Agassiz, Lias, Lyme Regis; a very fine mass of jaw, and numerous teeth of *Hybodus reticulatus*, Lias, Lyme Regis; slab with numerous large and fine teeth of a species of Hybodus, Lias, Lyme Regis; very fine congeries of back teeth of a *Hybodus*, seemingly the same species as the last specimen, from the Lias of Lyme Regis, collected by J. Johnson, Esq.; two large wide-based teeth with prominent central tubercles, from Lias of Lyme Regis; very long-pointed broken tooth, Lias, Lyme Regis; small slab with thirteen teeth, and a solitary tooth of Ichthyosaurus, from Lias, Lyme Regis: a fine congeries of large strong teeth of *Hybodus pyramidalis*, collected by J. Johnson, Esq., from the Lias of Lyme Regis; two small masses of teeth, Lias, Lyme Regis (Mantell Coll.): two teeth of *H. reticulatus*, Lias, Lyme Regis: isolated back tooth of *H. pyramidalis*, Lias, Lyme Regis; five foreign broken teeth of same species, from the Lias of Ohmden, collected by M. P. Mohr; three teeth of *Hybodus*, collected by Mr. Buy, from the Oxford Clay of Christian Malford, Wiltshire; front tooth, Oxford Clay, Christian Malford; some foreign broken front teeth, from the Bone-bed of Crailsheim, collected by M. P. Mohr; single back tooth of *H. raricostatus*, labelled "Trias," Aust Cliff,—an assignment we doubt the correctness of. Several front teeth of *Hybodus minor*, Agassiz, from the Lias Bone-bed at Bristol; two foreign back teeth of *Hybodus plicatilis ?*, from the Muschelkalk (? S. J. M.) of Baireuth, collected by M. P. Mohr; other foreign teeth, assigned to the same species, from Muschelkalk (?) of Baireuth (Mohr and Dr. Braun), Halle (Mohr), Leineck (Dr. Braun), and *H. obliquus*, Baireuth, Leineck (Braun), (sp.?) Leineck (Braun); *H. longiconus ?*, Ag., from Bone-bed of Crailsheim (Mohr), *H. rugosus*, Pl., from Bone-bed of Crailsheim and Halle (Mohr), *H. sublævis*, Ag., from the Keuper of Würtemberg (Dr. Krantz), *H. cuspidatus* (Krantz), and an unassigned front tooth from the Keuper of Wurtemberg, collected by Dr. Krantz. There are also to be added to the British specimens a small fragment of the Aust Cliff rock, with teeth of *Hybodus*, and which fragment is referred on the tablet with a query to the "Trias." In addition to these are numerous fin-rays in the wall-case, No. 7, in the North Gallery, referred to various species, but for the present we reserve our remarks on these.

We regret we cannot go at greater length now into the investigation of this interesting genus. The specimen we have figured, however, is well worthy of accurate description, and on no finer one has any species of *Hybodus* yet been founded. I propose the specific name of *Dubrisiensis* for it, and will give in our next number a descriptive summary of distinguishing characters and enlarged figures of the minute teeth, which require more care and delicacy of drawing, and consequently time, than I can possibly at this moment give to them.

CRUSTACEAN TRACKS IN POTSDAM SANDSTONE.

The following interesting letter by Professor Hall (31st Oct. 1862), "On a New Crustacean, from the Potsdam Sandstone," was published in the December number of the 'Canadian Naturalist.'

I have been much interested in reading your observations upon the tracks of Limulus in sand, and comparisons with the tracks in the Potsdam Sandstone;* more especially as these observations connect themselves in a remarkable manner with a recent discovery of my own; and a question may arise as to whether you have described an animal which I have found, or I have found the animal corresponding to your description. I will leave you and the scientific world to judge of the facts. However, after what you have written, I cannot now publish what I communicated to the Albany Institute last winter, without referring to your paper; and in the meantime you may lay this note before the Montreal Natural History Society, and publish it, or such parts of it, as you please.

In February last, I communicated to the Albany Institute a notice of a new crustacean from the Potsdam Sandstone of Wisconsin, and subsequently I sent a drawing of the same to M. Barrande. In 1855, I obtained from the Potsdam Sandstone of the Upper Mississippi River, a fragment of what appeared to be a spine of a crustacean, of very remarkable and peculiar structure, reminding one of that bone; and which might at one time, before we had accustomed ourselves to limit the geological range of fishes, have been taken for an ichthyic remain.

This fragment remained in my collection a subject of much interest, for I was aware, from its structure, that it could belong to no genus of Trilobites, but at the same time I did not think it worth while to publish any notice of it from its incompleteness.

In 1857, Mr. Daniels, of the Geological Survey of Wisconsin, discovered in the Potsdam Sandstone of Black River, in that State, tracks similar to those described by Sir W. E. Logan in the sandstone of Canada. This added a new interest to the unknown crustacean fragment; and in 1860 I visited the Black River region, to procure, if possible, some of these impressions. I failed however in finding the precise locality; and in 1862

Fig. 1.—Shield of Crustacean, from Primordial Zone.

sent my assistant in the Wisconsin survey, Mr. Hale, to make further explorations, but he did not succeed in finding anything of interest. At another locality, however, he obtained some fragments of the crustacean before mentioned, among which are two cephalic shields sufficiently perfect to be characterized. I enclose you a drawing of one of these.

* 'Canadian Naturalist' for August, 1862.

ıes to prove that thermal intensity, whether it be a wave (a ı fluid, is not uniform. Light and heat cannot be uniformly rough space, for the causes that generate them are not uni-l to intensity and distance.

limit of the thermal ocean in space must be almost infinitely ıd there is no evidence that refrigeration proceeds in a uni-m the centre to the circumference of the material universe, ıy proof that our system revolves in a circle equidistant from ıtre. There is therefore no evidence whatever that our path is isothermal. It has also been stated by the editor of the ıat to say, that the present meteorological changes on our fficient to explain the glacial eras, is merely a dogmatic asser-y I have only to say, that if it be a dogmatic assertion, it is ıth in the invariable certainty and sequence of natural law, the wonderful and hitherto unexplained fact, that the polar enjoyed the climate of Italy?—that the *Sequoia Langsdorfi* plant), the walnut, the plane-tree, and the vine once flourished ctic Circle? (Steenstrup and Beer.) Is it not an incontrover-Mount Lebanon was once covered with ice and snow? I ıe universally admitted that these facts are incapable of ex-ıny known laws of our present telluric meteorology, and also through space is not isothermal, which latter supposition, it is by physical facts, will fully explain all the phenomena of ıciation.

the question in the last number of the 'Geologist,' "what ed temperature of the old cosmical space through which our ypothetically supposed to have passed in the glacial age?" I ıat the solution to this query can only be found in vital ther-ı the changes north and south of the isozoic zones. For it is at during the period the earth was passing through the cold ace the isozoic zones moved towards the equator; and that passing through warmer regions of space, the isozoic zones ıarer the poles. Therefore from the changes of the isozoic earth's surface, an approximate calculation might be made of osmical temperatures through which our solar system passed lacial geological periods so clearly recorded on the earth's

ɾ exist where matter is, it must be subject to the laws of matter, and as would be in direct correlation with the other physical forces; and if heat natter, how can we speak of hot and cold regions of space, where by that neither heat nor cold can be? Again, if confined to matter, it will, as is concerned, be confined to that matter with which our earth is in con-ıeat sphere of ethereal matter surrounding the sun, which is warmed by by his light, put in motion by his attraction or repulsion. If the sun his surrounding worlds, these will all travel onwards together in the same ıl envelope; and therefore, unless the supposed hot and cold regions of ıeratures of much higher or much lower degrees than the general [illegible] olar region, the effect would be imperceptible. In this event, must we adiation inwards of heat from space towards the sun, and consequently, ıct, a stoppage of all radiation from the earth? But heat is a form of ıtion seemingly necessitates the existence of matter. If so, therefore [illegible] ıce—all space without end must be material. Can heat or cold exist in here is no cause whatever, no physical action, that I know of, that could ır accumulate heat in space or produce heated masses of space. Chemical ıd chemical decompositions of matter might produce spheres of heated but we have no data yet for such an assumption.—Ed. Geol.]

The relations to Limulus are at once suggested by the form and expression of these carapaces, while the large prominent eye-tubercles hold relatively the same position as the small approximate oculiform tubercles or spots on the anterior part of the shield in Limulus (and also in Eurypterus). The carapace is proportionally flatter than in Limulus, and has, like that, a strong thickened border; the posterior angles rounded. The margin is impressed or sinuate in front, and there are slight indications of longitudinal grooves on each side of the central, leaving a median lobe proportionally wider than in Limulus. The eyes, though imperfect, remind one somewhat of the eyes of Trilobites, and are remarkably prominent.

There is a single fragment of what appears to have been an articulation of the thorax, or a portion of some appendage analogous to the branchial feet of Limulus; it has a flattened, curving, pointed extremity. Another fragment I infer may have been the caudal extremity, it is comparatively thick and strong; but the specimen is too imperfect to be determined. The first specimen I obtained is a straight spine-like body, and I infer that the animal may have been provided with a caudal spine, as in Limulus.

Such, in general, are the characters of this crustacean. Whether this may have been the animal which made the peculiar tracks in the sandstone, I cannot say, but I have so inferred. The first specimen was found at a distance of thirty miles or more in a north-westerly direction from the locality of the tracks of Black River, and in higher beds of the sandstone. The last found specimens are from a more distant locality, in a south-easterly direction, and also from beds above those of the tracks. All this, however, cannot furnish matter for argument against the origin of the tracks, in the present state of our knowledge of a country which has been comparatively but little explored.

Whatever may be proved hereafter in this respect, it does not diminish the great interest attaching to so new and remarkable a form of crustacean from the unequivocal primordial zone of the north-west.

CORRESPONDENCE.

Causes of Cosmical Changes of Temperature on our Planet.

It is the essential character of space to be infinite. It can have no end. The negation of limit becomes the transcendental affirmative of the infinite. Not so of matter; matter is finite, its position in space being regulated and determined by universal resultants, the effects of its mass and attractions. Heat can only exist in that portion of space which is occupied by matter; for whether caloric be a fluid or a wave, it can have no existence in pure space where no matter exists, pure space being a negation of everything that is material. It necessarily follows that the thermal portion of space must be material.

Mr. Mackie's supposition, in the last number of the 'Geologist,' that the cosmical temperature of space should be the [illegible]
heat, is correc[illegible]
absence of [illegible]
mere ne[illegible]
tained. [illegible]
gions [illegible]
as a s[illegible]

...es to prove that thermal intensity, whether it be a wave (a ... a fluid, is not uniform. Light and heat cannot be uniformly ... rough space, for the causes that generate them are not uni- ... d to intensity and distance.

... limit of the thermal ocean in space must be almost infinitely ... nd there is no evidence that refrigeration proceeds in a uni- ... m the centre to the circumference of the material universe, ... ny proof that our system revolves in a circle equidistant from ... ntre. There is therefore no evidence whatever that our pat... is isothermal. It has also been stated by the editor of the ... hat to say, that the present [illegible]

[illegible]

The Portland Ossiferous Fissures.

SIR,—The Rev. T. Allen's letter on the Portland fissures in your last number, induces me to send you a second communication upon that question. I have visited Portland during the present month, and descended one of the fissures, in which a large number of bones were found some months ago by a warder of the name of Maddock. I obtained all the information I was able from Mr. Maddock on the subject, and saw most of the bones. They are deposited in the Government Office at the Vern Fort. Lieutenant Home, R.E., was kind enough to allow me to examine them thoroughly, and gave me much information and assistance in investigating the phenomena of the gullies.

I must premise that I did not examine any gullies in that portion of the island where the Portland beds are overlaid by the Lower Purbeck calcareous shale.

Fig. 1.—Section showing the Portland fissures. *a*, stone, fissured; *b*, sandy clay; *c*, shaly clay.

I saw at a glance that the explanation I offered in a former communication to your Journal was incorrect. *Shrinkage* will not account for these fissures. They appear to arise from a ponderous stone-structure being raised by nature on a bad foundation.

They extend as nearly as possible in the direction of the length of the island; and are possibly connected with the last great movement, which affected the configuration of that part of the coast. This movement seems to have been posterior to the outspread of gravel on the heights to the north of the Ridgway fault: for the elevated beds to the south of the fault are bare of gravel.

On the west side of the northern end of Portland the beds are much broken and tumbled seawards, the gullies being very numerous. Slips occur on this side of the island. On the whole, I conclude that Portland is the remnant of an oblong mass of strata brought into its present position by the disturbances alluded to. There is a very curious miniature model of the island between Upwey and Bincombe, formed by the combined effects of faulting and denudation, and in the same series of beds that occur at Portland itself.

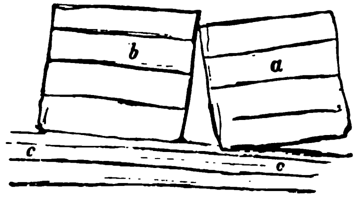


Fig. 2.—Ideal section showing nature of slip of beds in forming a fissure: *a*, *b*, masses of stone-rock, subsiding on the unequally-yielding bed of sandy clay, *c*.

The general structure of the gullies seems to be due to a slip of such a kind that they are more open at the bottom than at the top. (Fig. 2.)

One side has usually slightly sunk a foot or so. The jagged edges of broken stones and flints correspond on the two sides of the fissure. The rock seems a good deal shaken on both sides of the larger fissures.

With regard to the question of the fissures being open or closed at the top, the above description of them will show that, on the whole, they tend to be closed. Yet they are not so entirely. Often they seem to be roofed by fragments that have fallen in from their sides, and have got jammed, and subsequently smaller fragments and rubbish have accumulated upon

Certainly at the present day there are no gaping chasms on the e of the island, and this may have led to its being commonly said he gullies are closed at the top. It seems probable that, where the re Portland rock is capped by slaty stone, the latter may have con- l to roof the fissures, and, as a rule, the fissures may not affect the cks; but I cannot speak on this point from observation.

;he fissure which I entered I was stopped by a true talus of surface- l, abounding in Helices and Cyclostomæ, with a few splinters of bone. materials had most evidently been gradually introduced through orifice in the upper surface by the action of rain. I may have sed the fissure for about fifty yards. The true bottom was not visible; quantity of loose stones had been cast into it. The part of it where ones were found is now choked up. I should conclude, from the ption which Mr. Maddock gave me, that the bones, in falling from , lodged upon a ledge of rock; and probably, if the base of the e were reached, many more would be found there.

iong these bones were no human bones. I did not see any such that een found in the fissures in the Government works, but I saw a sling- . formed of Portland flint, which Lieutenant Home assured me he imself taken from a gully, at a depth of 80 feet from the surface. lso told me that he had once in ossession a brecciated mass of , containing among them human ; and that it had been found in y in making the ditch of the fort, 1at it had been stolen.

Fig. 3.—Section of gully, N.W. side of Vern Hill, Portland.

e explanation given above of the of the formation of the fissures .t which commends itself to the igent persons engaged upon the rnment works, and was suggested in the first place by Mr. Home. join a sketch of the top of a gully e north-west side of the Vern Hill, looking north.

this case the gully was evidently once open, though now filled with e. The beds have sunk about two feet on the east side.

I remain, Sir, faithfully yours,

ustead, Colchester, June 17*th*, 1863. O. Fisher.

The Portland Ossiferous Fissures.

1,—With reference to Mr. Allen's letter in your number for last h, I beg to say that I do not doubt the truth of his statement, but ly the soundness of the inferences drawn therefrom. I presume he is e that in what he says about the "deluge" and the bones of extinct 1ls he is opposed to some of the most advanced geologists of the pre- lay, in the opinion of whom the idea of a "universal deluge" must ven up, and who also think that the fossil remains of elephants, rhi- oses, etc., belonged to species peculiarly adapted to exist in a tem- e and even a comparatively arctic climate, of which the "Siberian noth" and woolly rhinoceros mentioned by Professor Owen, in his ory of British Fossil Mammalia,' are appropriate examples. Hoping vill excuse my thus trespassing on your valuable space,

I remain, yours truly,

Charles Jecks, jun.

odlands, Thorpe, near Norwich, June 8, 1863.

The Portland Ossiferous Fissures.

SIR,—In answer to the objections, which you have made in the last number of the 'Geologist,' to my opinion of the cause of the remains of men and of extinct mammalia being found in fissures of the Portland rock, which fissures do not extend to the surface of the rock, will you allow me to make a few observations?

In the first place, I think there can be no doubt that human and other bones have been thus found. This fact, as I have before stated, is positively asserted in 'Willis's Current Notes' for August, 1852, and in an article in the 'Times' of the 1st of last January; and has been frequently confirmed to me by Captain Manning, of Portland Castle, who has shown me the bones of men, of elk, reindeer, elephant, and of other animals which were found associated together in fissures, which, he said, did not extend to the surface of the rock. You say: "How could there be a fissure before the rock was consolidated, and are we to believe that the elephants, etc., and men too, lived at the bottom of the sea, as they must be supposed to have done if we accept Mr. Allen's theory?" But in both of my letters, I said that I believed that the human and other bones must have been imbedded in the rock *before* its consolidation, and consequently before the existence of any fissures; and that, therefore, the men and animals to whom they belonged must have lived on some other dry land, which probably no longer exists. My opinion is, that these fissures were gradually formed in the semi-fluid limestone deposit, partly by the human and other remains embedded in it and the putrid vapours arising from their corrupting bodies, and partly by the contraction of the calcareous deposit during the process of its drying. I believe that all the remains were imbedded in the soft limestone at that interchange of land and sea of which M. Cuvier speaks in the following words:—"I conclude," he says, "with M. de Luc and M. Dolomieu, that if there be any fact well established in geology it is this, that the surface of our globe has suffered a great and sudden revolution, the period of which cannot be dated further back than five or six thousand years. This revolution has, on one hand, engulfed and caused to disappear the countries formerly inhabited by men and the animal species at present best known, and, on the other, has laid bare the bed of the last ocean, thus converting its channel into the present habitable earth." I think, also, that there is the strongest geological proof that the remains of extinct quadrupeds found in caverns in limestone, were imbedded in the limestone *before* its consolidation, and, consequently, before the existence of the caverns themselves; and that therefore the animals to whom they belonged must have previously inhabited some other dry land. For there is evidence that many of these caverns have had no mouths as none have as yet been discovered, at Oreston, near Plymouth. Dr. Buckland, in his 'Reliquiæ Diluvianæ,' mentions three of these caverns, in which were numerous remains of extinct mammalia, which were only discovered by men digging in a quarry for stone for building the Plymouth breakwater. He says that these caverns were "discovered by Mr. Whidbey in removing the *entire mass of a hill* of transition limestone, and that none of them had any discoverable communication with the surface of the earth. In the 'Times' of January 22, 1859, I read a statement that "there had recently been discovered in one of the limestone *quarries* at Oreston, the teeth, bones, and other remains of lions, tigers, elephants, rhinoceroses, horses, hyænas, and other animals. The cavern from which the fossils were extracted was situated in the solid rock in the cliff of a quarry. There was no aperture or other indication of its locality.

ıg the contents is the jaw of an animal of the horse species, in staite, exceedingly perfect." The fossils were said to be in the possesof Mr. Joseph, mineralogist, of Plymouth. In consequence of readhis account, I wrote to Mr. Joseph, requesting him to have the kindto inform me whether the facts mentioned in the 'Times' were in respect correct. He returned for answer that they were so; and that there was no aperture in the cavern, and that some of the bones imbedded in "compact rock." It appears from Dr. Buckland's 'Ree Diluvianæ,' that almost all, if not all, bone-caverns which have aperthrough which the animals could have passed are situated in the face ecipitous cliffs, produced, as Dr. Buckland says, by valleys of denun excavated by the retiring waters of a transient inundation. I ;, therefore, that except for the excavation of these valleys, the exce of the caverns would probably have never been known. The dale cave itself, which is full of the remains of immense mammalia, as Dr. Buckland says, only discovered by men digging in a quarry, thus laying open, to the extent of 30 feet, the cave itself, and forming, e perpendicular face of the quarry, an entrance of 3 feet high and 5 d. Dr. Buckland thinks that there may be many similar caverns in neighbourhood of Kirkdale, whose existence can only be discovered their casual intersection by some artificial operation;" and he says "in these circumstances we see a reason why so few caverns of this have hitherto been discovered, although it is probable that they are numerous." From the fact that few, if any, bone-caverns have been overed with apertures through which animals could have passed, except rns situated in the face of precipitous cliffs, produced, according to Buckland, by diluvial denudation, it seems to me certain that all bonerns were only formed by the animal remains imbedded in the limestone osit before its consolidation, and, consequently, that the animals themes must have originally inhabited some other dry land which may no ger exist. Lastly, as almost all the fossil remains of men or animals ıd in caves are buried in loam, which, as Dr. Buckland asserts, was ied into the caves by an inundation, it is probable that the same water ch introduced this loam introduced the bones imbedded in it.

I am, Sir, your obedient servant,

THOS. D. ALLEN.

ectory, North Cerney, Cirencester, June 12, 1863.

How were the bones of men, mammoths, and reindeer separated and deposited only in forming fissures in a semifluid limestone? The bones of men, mammoths, and reindeer ld have been commingled *with* the shell-fish and other marine remains in the Portland , if they had existed at that period and were washed into the Portland Sea. Mr. Allen better honestly look at the sections, fissures, and limestones for himself, and get some ıe human and mammal bones out in the presence of good and able witnesses, as M. de thes has lately done at Abbeville. It will be a hard matter for him to get the world to eve in Oolitic men and mammoths, unless on better authority than 'Willis's Notes' or a y paragraph in the 'Times.' Ossiferous fissures are not rare. They occur in a vast ıber of places, and there is no reason to believe the infilled remains in the Portland ires are a whit more ancient than such remains are usually considered to be. Nothing yet turned up to show that man is not one of the latest-created animals, and as yet the slightest indication has been obtained in any part of the world of the existence of ıan beings in the Jurassic age. Mr. Allen's theory of the deposition of the extinct nals in caves before the caves existed is so ingenious and *naïve*, that we leave it withcomment for the amusement of our readers, for fear our remarks might spoil the joke. the allusion to the Oreston quarries, we presume Mr. Allen wishes to infer that there e men in the mountain-limestone age. Are we shortly to be treated to footprints of and works of his architecture and handicraft in the Cambrian slates? Mr. Allen

must not expect many converts to his geological heresy unless he give us irresistibly convincing proofs. We are not willing to close our columns against any expression of opinion, however rash or wrong it may at first sight appear,—the wildest might turn out right at last; but we cannot permit any further discussion of these Portland fissures, unless positive sections to scale with the position of these mammal bones or some practical details are submitted to us.—ED. GEOL.]

Age of the Trinidad Strata.

DEAR SIR,—Perhaps you will allow me to make a remark in connection with a statement occurring in Mr. Guppy's paper on the Parian Formation of Trinidad. He mentions sandstones containing a Trigonia, Belemmites, and other fossils belonging to a period represented by a series of rocks on the continent of Europe, known as the Neocomian. What I wish to suggest is, that it is more than probable that the beds in Trinidad were not of Neocomian age, as Mr. Guppy says. Are we to suppose it probable, or even possible, that there was no variation of fauna in geological periods, and that the occurrence of two or three species of mollusca together in different localities, furnishes proof of their existence? Can geologists point to certain species of shells, and say, "Wherever these are found together imbedded, we know the rocks containing them to have been contemporaneous"?

Suppose the existing fauna of the world to become fossils, where should we find species to characterize it? By what two or three species would a geologist be able to distinguish the deposit from any that preceded it? Would he not be very likely to place the Australian beds as contemporaneous with our Oolites (the absence of Cephalopoda being the only remarkable difference)? and he would most probably, according to the system now pursued in geological classification, assign a different period to nearly every existing fauna. Geologists are, it seems, too much impressed with an idea of "contemporaneity." As Professor Huxley said, in his Address to the Geological Society, 1862, "it would have been very much better for geology if so loose and ambiguous a word as 'contemporaneous' had been excluded from her terminology, and if in its stead some term expressing similarity of serial relation, and excluding the notion of time altogether, had been employed to denote correspondence in position in two or more series of strata." Professor Huxley proposes to substitute the word "homotaxis" as more correct, and avoiding the production of an erroneous impression. Edward Forbes was in the habit of asserting that the similarity of the organic contents of distant formations was *primâ facie* evidence, not of their similarity, but of their difference of age. It would be well if geologists were more attentive to these facts. Many conclusions which are now held as undeniable would be shaken from their foundations, and geology would have a difficulty removed from her path which must sooner or later make itself known. E. R. LANKESTER.

Remarkable Coal-Plant.

SIR,—I have lately found in a seam of coal a stem of Sigillaria which throws considerable light on the compound character of some of our common Coal-plants, and tends somewhat to simplify a portion of fossil botany. The circumference of the specimen is 1 foot 6 inches, and after the removal of a coaly envelope of outer bark, presents the irregularly-ribbed and furrowed surface, with occasional scars, so often seen on old Sigillariæ and their main roots. The central axis is cylindrical, and shows on its transverse section a *Medullosa* resembling one described by Cotta. The outside of this cylinder is striated longitudinally, like a Calamite, and not to be distinguished from the *Calamites remotus* of Brongniart. Next comes a cylinder of wedge-shaped bundles of barred vessels, in radiating series, parted by spaces resembling medullary rays, in all respects similar to that found in *Stigmaria*, *Sigillaria*, and *Anabathra*. Outside of the last, with a small interval, is another cylinder composed of vessels not barred, arranged in radiating series, and parted by large wedge-shaped bundles of vessels running towards the circumference. The structure of this outer cylinder is identical with that of *Calamodendron*, and its exterior has the irregularly-ribbed and furrowed appearance previously alluded to.

Yours truly,

EDWARD WILLIAM BINNEY.

Manchester, June 10th, 1863.

FOREIGN INTELLIGENCE.

The question of the contemporaneity of man with extinct species of animals has again been brought before the Academy of Sciences by a paper of M. J. Desnoyers, on the 8th ultimo, in which he announced his having met with materials indicating the co-existence of man with the *Elephas meridionalis*, in a deposit in the environs of Chartres, of greater age than the drift of the valleys of the Somme and the Seine. These indications are kinds of notches or streaks made by the human hand, which he has observed on many of the fossil bones of many of the great extinct mammals found in that deposit at Saint-Prest, near Chartres. M. Desnoyers also notices indications of the same character in bones from other localities. The conclusions deduced in his paper are—that fossil bones of *Elephas meridionalis*, *Rhinoceros leptorhinus*, *R. Etruscus*, *Hippopotamus major*, many of large and small deer, and other species of mammifers characteristic of the Upper Tertiary or Pliocene strata, discovered in an undisturbed deposit of that geological age, bear numerous and evident traces of notchings, scratches, and cuts which are perfectly analogous to those which have been observed on the fossil bones of other more recent species, some of which, now extinct, accompanied the *Elephas primigenius*, *Rhinoceros tichorhinus*, *Ursus spelæus*, *Hyæna spelæa*, etc., and others still living, such as the Reindeer and other deer, the Aurochs, etc., but remains of which are found commingled together in ossiferous caverns, in drift-beds, or in peat. Like vestiges have been met with on numbers of bones of existing species in the excavations for houses, and in Celtic, Celto-Roman, and Saxon graves. The marks noted on the fossil bones from the most ancient beds appear to have had, for the most part, the same origin as those on the more recent bones, and cannot be, so far as we yet know anything to the contrary, attributed to any other source than the act of man. Other striæ, finer, rectilinear, and inter-crossing, which are seen also in great number on the bones from the Pliocene deposit of the neighbourhood of Chartres and from other localities, are analogous to those seen on striated and rolled boulders of ancient and modern glaciers. The section at Saint-Prest, unanimously recognized as Upper Tertiary, or Pliocene, and anterior to all the quaternary beds containing remains of *Elephas primigenius*, yields numerous bones of *Elephas meridionalis* and other of the great kinds of mammalia characteristic of the Pliocene beds.

From these facts, then, it is possible to conclude with a strong appearance of probability, that man inhabited the soil of France before the great and first glacial era, contemporaneously with the *Elephas meridionalis* and the other species of fossil mammals of the Val d'Arno, in Tuscany, which are identical with those of Chartres, and which species are Tertiary, and more ancient than the *Elephas primigenius* found with the relics of man in the diluvial beds of valleys and caverns.

The Saint-Prest bed offers the most ancient example yet given in Europe of the vestiges of man with the extinct beasts. It diminishes in no way the interest and importance of the Abbeville and Amiens discoveries, but, on the contrary, confirms their reality by a new argument, and by totally independent observations the evidence recently obtained by M. Boucher de Perthes and verified with so much care by the naturalists of England and France.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Royal Institution of Great Britain.—*June 5th.*—"On the Forms of the Stratified Alps of Savoy." By John Ruskin, Esq., F.G.S. The purpose of the discourse was to trace some of the influences which have produced the present external forms of the stratified mountains of Savoy, and the probable extent and results of the future operation of such influences.

The subject was arranged under three heads:—I. The Materials of the Savoy Alps. II. The Mode of their Formation. III. The Mode of their subsequent Sculpture.

I. *Their Materials.*—The investigation was limited to those Alps which consist, in whole or in part, either of Jura limestone, of Neocomian beds, or of the Hippurite limestone, and include no important masses of other formations. All these rocks are marine deposits; and the first question to be considered with respect to the development of mountains out of them, is the kind of change they must undergo in being dried. Whether prolonged through vast periods of time, or hastened by heat and pressure, the drying and solidification of such rocks involved their contraction, and usually, in consequence, their being traversed throughout by minute fissures. Under certain conditions of pressure, these fissures take the aspect of slaty cleavage; under others, they become irregular cracks, dividing all the substance of the stone. If these are not filled, the rock would become a mere heap of débris, and be incapable of establishing itself in any bold form. This is provided against by a metamorphic action, which either arranges the particles of the rock, throughout, in new and more crystalline conditions, or else causes some of them to separate from the rest, to traverse the body of the rock, and arrange themselves in its fissures; thus forming a cement, usually of finer and purer substance than the rest of the stone. In either case the action tends continually to the purification and segregation of the elements of the stone. The energy of such action depends on accidental circumstances. First, on the attractions of the component elements among themselves; secondly, on every change of external temperature and relation. So that mountains are at different periods in different stages of health (so to call it) or disease. We have mountains nguid temperament, mountains with checked circulations, mountains vous fevers, mountains in atrophy and decline.

s change in the structure of existing rocks is traceable through con- is gradations, so that a black mud or calcareous slime is impercepti- odified into a magnificently hard and crystalline substance, enclosing of beryl, topaz, and sapphire, and veined with gold. But it cannot ermined how far, or in what localities, these changes are yet arrested; plurality of instances they are evidently yet in progress. It ap- rational to suppose that as each rock approaches to its perfect type ange becomes slower; its perfection being continually neared, but reached; its change being liable also to interruption or reversal by eological phenomena. In the process of this change, rocks expand tract; and, in portions, their multitudinous fissures give them a duc- or viscosity like that of glacier-ice on a larger scale. So that many tions are best to be conceived as glaciers, or frozen fields of crag, depth is to be measured in miles instead of fathoms; whose cre- are filled with solvent flame, with vapour, with gelatinous flint, or rystallizing elements of mingled natures; the whole mass changing nensions and flowing into new channels, though by gradations which t be measured, and in periods of time of which human life forms no ciable unit.

Formation.—Mountains are to be arranged, with respect to their ure, under two great classes—those which are cut out of the beds of they are composed, and those which are formed by the convolution tortion of the beds themselves. The Savoy mountains are chiefly s latter class. When stratified formations are contorted, it is usually by pressure from below, which raises one part of the formation above st; or by lateral pressure, which reduces the whole formation into a of waves. The ascending pressure may be limited in its sphere of ion; the lateral one necessarily affects extensive tracts of country, e eminences it produces vanish only by degrees, like the waves left wake of a ship. The Savoy mountains have undergone both these of violence in very complex modes and at different periods, so that omes almost impossible to trace separately and completely the opera- f any given force at a given point.

speaker's intention was to have analysed, as far as possible, the ac- f the forming forces in one wave of simple elevation, the Mont Sa- and in another of lateral compression, the Mont Brezon: but the igation of the Mont Salève had presented unexpected difficulty. Its had been always considered to be formed by vertical beds, raised hat position during the Tertiary periods; Mr. Ruskin's investigations n the contrary, led him to conclude that the appearance of vertical was owing to a peculiarly sharp and distinct cleavage, at right angles he beds, but nearly parallel to their strike, elsewhere similarly mani- in the Jurassic series of Savoy, and showing itself on the fronts of of the precipices formed of that rock. The attention of geologists nvited to the determination of this question.

compressed wave of the Brezon, more complex in arrangement, was clearly defined. A section of it was given, showing the reversed po- of the Hippurite limestone in the summit and lower precipices. This one-wave was shown to be one of a great series, running parallel he Alps, and constituting an undulatory district, chiefly composed of beds, separated from the higher limestone-district of the Jura and y a long trench or moat, filled with members of the Tertiary series— r nummulite limestones and flysch. This trench might be followed from Faverges, at the head of the Lake of Annecy, across Savoy. It separated Mont Vergi from the Mont Dorons, and the Dent d'Oche from the Dent du Midi; then entered Switzerland, separating the Moleson from the Diablerets; passed on through the districts of Thun and Brientz, and, dividing itself into two, caused the zigzagged form of the Lake of Lucerne. The principal branch then passed between the high Sentis and the Glarnisch, and broke into confusion in the Tyrol. On the north side of this trench the chalk beds were often vertical, or cast into repeated folds, of which the escarpments were mostly turned away from the Alps; but on the south side of the trench, the Jurassic, Triassic, and Carboniferous beds, though much distorted, showed a prevailing tendency to lean towards the Alps, and turn their escarpments to the central chain.

Both these systems of mountains are intersected by transverse valleys, owing their origin, in the first instance, to a series of transverse curvilinear fractures, which affect the forms even of every minor ridge, and produce its principal ravines and boldest rocks, even where no distinctly-excavated valleys exist. Thus, the Mont Vergi and the Aiguilles of Salouvre are only fragmentary remains of a range of horizontal beds, once continuous, but broken by this transverse system of curvilinear cleavage, and worn or weathered into separate summits.

The means of this ultimate sculpture or weathering were lastly to be considered.

III. *Sculpture.*—The final reductions of mountain form are owing either to disintegration, or to the action of water, in the condition of rain, rivers, or ice; aided by frost and other circumstances of temperature and atmosphere.

All important existing forms are owing to disintegration or the action of water. That of ice had been curiously overrated. As an instrument of sculpture, ice is much less powerful than water; the apparently energetic effects of it being merely the exponents of disintegration. A glacier did not produce its moraine, but sustained and exposed the fragments which fell on its surface, pulverizing these by keeping them in motion, but producing very unimportant effects on the rock below; the roundings and striation produced by ice were superficial; while a torrent penetrated into every angle and cranny, undermining and wearing continually, and carrying stones, at the lowest estimate, six hundred thousand times as fast as the glacier. Had the quantity of rain which has fallen on Mont Blanc in the form of snow (and descended in the ravines as ice) fallen as rain, and descended in torrents, the ravines would have been much deeper than they are now, and the glacier may so far be considered as exercising a protective influence. But its power of carriage is unlimited, and when masses of earth or rock are once loosened, the glacier carries them away, and exposes fresh surfaces. Generally, the work of water and ice is in mountain surgery like that of lancet and sponge—one for incision, the other for ablution. No excavation by ice was possible on a large scale, any more than by a stream of honey; and its various actions, with their limitations, were only to be understood by keeping always clearly in view the great law of its motion as a viscous substance, determined by Professor James Forbes.

The existing forms of the Alps are, therefore, traceable chiefly to denudation as they rose from the sea, followed by more or less violent aqueous action, partly arrested during the glacial periods, while the produced diluvium was carried away into the valley of the Rhine or into the North Sea. One very important result of denudation had not yet been sufficiently regarded; namely, that when portions of a thick bed (as the Rudistenkalk) had been entirely removed, the weight of the remaining masses essing unequally on the inferior beds, would, when these were soft (as e Neocomian marls), press them up into arched conditions, like those of e floors of coal-mines in what the miners called "creeps." Many ano- ılous positions of the beds of Spatangen-kalk in the district of the Lake Annecy were in all probability owing to this cause: they might be ıdied advantageously in the sloping base of the great Rochers de Lanfon, ıich, disintegrating in curved, nearly vertical flakes, each a thousand feet height, were nevertheless a mere outlying remnant of the great hori- ntal formation of the Parmelan, and formed, like it, of very thin hori- ntal beds of Rudisten-kalk, imposed on shaly masses of Neocomian, odified by their pressure. More complex forms of harder rock were rought by the streams and rains into fantastic outlines; and the trans- rse gorges were cut deep where they had been first traced by fault or stortion. The analysis of this aqueous action would alone require a series discourses; but the sum of the facts was that the best and most interest- g portions of the mountains were just those which were finally left, the ntres and joints as it were of the Alpine anatomy. Immeasurable periods time would be required to wear these away; and to all appearances, ıring the process of their destruction, others were rising to take their ace, and forms of perhaps far more nobly organized mountain would itness the collateral progress of humanity.

Manchester Scientific Students' Association.—The Association iginated in the latter part of 1861, by the efforts of a few ardent lovers science, who, stimulated by the recollection of the great pleasure they ıd derived from attending the sectional meetings of the British Asso- ation on the occasion of its visit to Manchester, conceived the project organizing in that city a permanent association, to enable students to eet frequently for the discussion of scientific topics, and to afford them pportunities of frequent intercourse. The institution numbers some seventy embers or more, and during the two sessions of last year, thirty lectures ere delivered and five *conversaziones* held, one of which latter was geolo- cal. Amongst the lectures were the following geological topics:—"The oal Formation and its Fossils," by Mr. G. Butterworth; "The Chemistry f Coal," by Mr. James Richards; "On Volcanic Action," by Mr. T. [oss; "Geological Traces of Primæval Man," by Mr. W. C. Unwin; Iron," by Mr. R. Drew; "The Chalk Formation," by Mr. S. Shirley; On Vertebrate Life—its History and Peculiarities," by Mr. G. D. Hatton; On Gold," by Mr. R. Drew. During the present year the geological ctures have been "The Hypozoic Rocks," by Mr. Richard Smith; "The owest Fossiliferous Rocks of England," by Mr. Samuel Shirley; "The evonian System," by Mr. George D. Hatton; "The Flora of the Coal- [easures," by Mr. William Grindon; "Ice as an Agent of Geological hange," by Mr. F. Carulla; "Fossil Saurians," by Mr. E. Butterworth. xcursions have also been made; amongst them, visits to the collieries of Vorsley and Pendleton, and to the copper and lead mines at Alderley.

Richmond Mechanics' Institute.—Mr. S. W. North, of York, has ctured on the antiquity of man. The title of his lecture was, "Has not [an existed a hundred thousand years?" The now, to geologists, fami- ır topics were treated with lucidity and perspicuity, the lecturer agreeing the recognized conclusions of the high antiquity of the human race, and e evidences of the fossil flint-implements which, as "works of his hands," considers speak in unmistakable terms of man's presence, and serve to l, not only of his existence, but something of his history."

Geologists' Association.—On the 20th ult. a number of the members this association assembled at Kew Gardens, where, under the guidance of Professors Tennant and Morris, they inspected minutely the various plants that have an interest for geologists; particularly the magnificent collection of ferns, in connection with the fossil ferns of the coal-measures. The plants that characterize the Oolitic and Tertiary beds were also illustrated with reference to modern groups. On the 24th ult. the Association made an excursion to Herne Bay and Reculver, where the most competent of the members delivered field lectures on some of the Secondary and Tertiary formations exposed on the coast between those places.

COTTESWOLD NATURALISTS' FIELD CLUB.—A most interesting and numerously attended meeting of this Club took place on 27th May, at Bownhill, Woodchester, where, by the permission of William Leigh, Esq., the proprietor of the estate, a tumulus was opened, under the superintendence of Mr. E. Witchell and Dr. Payne, of Stroud. On leaving the barrow, Mr. Samuel S. Marling, of Stanley Park, invited the Club to luncheon. From this point the President and Secretary proceeded, under the guidance of Mr. Witchell, to a neighbouring brick-kiln, to examine the fullers'-earth; thence to Penwood Quarry, where the bastard freestone is laid open to a depth of twenty-five feet, upon which rests the lower trigonia bed with its characteristic fossils; and onwards to a freshwater formation, exposed during the excavation of a reservoir on the side of the hill, at a considerable elevation above the town. From the organic contents it was presumed to represent the bottom of a small hill-lake, of which the margin towards the vale has long been swept away. The shells found in it comprise the same species which are constantly found in the tufaceous accumulations of the district, and which still inhabit it—*Cyclostoma elegans*, *Helix rotundata*, *H. umbilicata*, *Pupa umbilicata*, *Zua lubrica*, *Azeca tridens*, and *Carychium minimum*, as land-shells; *Valvata piscinalis*, *Lymnæus truncatulus*, and two or three species of *Pisidium*, as water-shells. The Rev. S. Lysons, availing himself of the presence of Dr. Thurnham, and Mr. Cunnington, of Devizes, Mr. D. Nash, and other ethnologists from Cheltenham, submitted for examination four skulls exhumed by him from the tumulus recently opened at Rodmarton. After dinner at the George Hotel, several gentlemen took part in a long and animated discussion on the events of the day, and upon the views expressed in a paper, by Captain Bell, "on the rough unhewn Stones of Cromlechs, Circles, and Chambered Tumuli," in which he inclined to the opinion that no tools were used upon them from superstitious motives, or reverential feelings due to the wide diffusion of the divine command repeatedly referred to in the Scriptures, where altars are especially mentioned as of unhewn stone.* He argued that the tool-marks were not absent from want of skill on the part of the mound-formers, as a knowledge of the powers of the lever, and the construction of sledges upon which ponderous masses were probably removed, implied familiarity with tools of various descriptions. Mr. D. Nash doubted whether iron had not been used, and believed that the stones uncovered today, if not hewn, had been shaped to fit them for the purpose to which they were applied. He did not assign to the barrows of this district the high antiquity attributed to them by many antiquaries, and thought that our knowledge of the race by whom they were constructed had become more confused, instead of more clear, by recent discoveries. He thought that the majority of them were of a period subsequent to that of the Roman dominion in Britain, and that they were the work of a people which had derived the civilization to which it had attained from the Romans, and were therefore of Romano-British origin.

* I have long thought it possible that some of these unhewn stone monuments may be relics of perhaps even the flint-implement men, or, at any rate, a very early race; and have more than once published the idea.—ED. GEOL.

Mr. Cunnington exhibited a beautifully-finished flint celt or adze, nine ıd a half inches long by three wide at the edge, which had been found, ith others, during the present year, at Crudwell, near Malmesbury.

A letter was read from Professor Buckman, accompanied by a geological ction, announcing the discovery in Cirencester of a patch of Cornbrash, owing that, as its environs consist of Forest marble and Great Oolite, the wn itself is situated in a valley of depression. A letter of thanks from the eological Society for the contribution to its library of the "Proceedings" the Club was then read, as was also an invitation to meet the Malvern ub at Dudley, on the 18th of June, from the newly-established Severn alley Naturalists' Field Club, whose head-quarters are at Bridgnorth.

The proceedings terminated with a paper by the Rev. S. Lysons, on the Names of Places in Gloucestershire."

MANCHESTER GEOLOGICAL SOCIETY.—*March 31st.*—A very important per was read by Mr. Joseph Dickinson, the President, "On the Coal-rata of Lancashire."

In the first volume of the Transactions of this Society there are papers On the Geology of Manchester and its Vicinity," and "On the Geology the Lancashire and Cheshire Coal-Fields," by Mr. Binney. These pers were given about 24 years ago; but although so many years have apsed since they were written, Mr. Dickens testified to the accuracy which aracterizes most of the information they contain. The author's purpose his present paper was to give an account of the whole subject, and, in oing so, to "Tell not as new what everybody knows," but, whilst fully ac-owledging former authorities, to supply required corrections, together ith additional matter of his own.

The base of the Lancashire coal-formation rests upon the mountain lime-one, which is seen cropping out near Clitheroe; within no part of the area the coal-field, however, are the lower measures so much exposed as to hibit the limestone. It is covered by a very thick deposit of shales and it, the thickness of which has never yet been correctly ascertained, but obably thicker than at any other part in England.

At the boundary between Lancashire and Cheshire the lowest workable al-seams crop out at Mossley, near Staleybridge; they then skirt round ear the eastern boundary of Lancashire, passing at certain places into orkshire (where sometimes, without having cropped out, they dip away gain in the opposite direction, and become overlaid by the whole of the orkshire coal-field), through to Littleboro'; thence midway between acup and Todmorden, passing near the Portsmouth station on the railway etween Todmorden and Burnley; then gradually curving a little to the est, including the Worsthorn quarries, and so on nearly to Colne; thence urning in a westerly and south-westerly direction, along Padiham Heights, rough Simondstone and Read, where the crop becomes very steep, dip-ing almost at an angle of 45°; then, leaving Blackburn outside, they pass rough Oswaldtwistle to Eccleshill, Over Darwen, across to Chorley, und by Welsh Whittle, Heskin, and thence to Latham Park and Blague-ate; then southward, keeping a little to the west of St. Helens. On the uth side the coal strata are overlaid by the Red Rock, or New Red Sand-one, Permian, etc.

The line thus given forms nearly half a basin, and throughout the entire ngth the general inclination of the strata is inwards to a centre,—the clination or dip being very much varied by the different faults with hich the basin is divided, from nearly level to an angle of 45°.

The coal-measures included in this Lancashire field have been divided o three series, namely,—the lower, or Gannister, the middle, and the upper series. As a general rule, it is said that the lower, or Ga series, contains some of the best coking coals. It also contains th flags and tile stones. It is the principal earth for making fire There are plenty of similar earths in the middle and upper series; would seem that those in the lower series produce bricks which stand heat. Like the coals of the lower series, those of the lower portion middle series are chiefly good coking coals; and at the top, or uppe tion, swift or hot-burning coals are produced. The coals of the series are nearly all hot swift-burning coals. Cannel or Parrot found in each of the three series, but the best is in the middle series

Commencing at Mossley, near Ashton-under-Lyne, the following of the lowest coals is met with:—

	yds.	ft.	in.
Sandstone	—	—	—
COAL	0	1	5
Floor earth	0	0	8
Shale and sandstone	29	2	4
Shale	0	2	0
COAL, Victoria	0	1	9
COAL and Bass	0	0	9
Earth	0	0	2
Sandstone	1	0	0
Shale	5	0	0
Sandstone	3	0	0
Shale	4	0	0
COAL	0	0	7

The lowest of these three coals lies at a distance of about 326 yards the Gannister coal. The principal, or 1 foot 9 inch bed, is the one is being worked at the Victoria Colliery, at Mossley. The three retain their character southwards to Early Bank, in Cheshire; but wards they do so for a short distance only, and, except in that imm neighbourhood, there is no place in Lancashire where coal-seams are s developed so low down in the coal-field.

A general section of the principal coal-seams of the lower serie Hartshead is as follows:—

	yds.	ft.	in.
COAL (40-yards mine) . . .	0	1	6
Strata, with an inch of COAL .	34	0	0
COAL, upper foot	0	1	0
Strata	15	0	0
COAL mountain, or ½ (Gannister)	0	1	10
Strata	10	0	0
COAL, lower foot	0	0	6
Strata	90	0	0
COAL, yard (sand rock) . . .	0	0	6
Strata, about	180	0	0

And then the upper, or one-foot five-inch coal, given on the preceding section, at Mossley.

At Crompton, near Oldham, the lower foot coal is called the hal mine, and the Gannister coal is still called the "mountain mine." The foot and the 40-yards coal are also still known by the same names. upper foot coal has there a large number of round nodules both in upon it, and also a very large number of fossils, generally *Goniatit* *Avicula-pectens*.

At Bamford and Ashworth, the 40-yards coal still retains its nam ere is another coal, called the "bassey mine," lying about 30 yards ove it.

At Birchinley, near Rochdale, the coals still retain the same names, and so at Dearnley and Cleggswood. Passing on through Whitworth and Wardle to Bacup, the 40-yards mine takes the name of the little or top, or alf-yard mine. At Whitworth, Wardle, etc., portions of the Gannister al, where it originally crop~ed out all round some of the hills, have been itirely worked out, and small workings are commenced on the lower foot-ine. The Gannister coal at Bacup is called the yard, or main coal; the wer foot and the sand-rock mines still retaining their names.

Up to this point there is no difficulty whatever in following the order in hich these coals lie. The strata follow each other with surprising regu-rity, seldom varying more than 10 yards in thickness between the same al-seams.

About a mile and a half to the north-east of Bacup one of the large faults sses in a north-westerly direction, causing some alteration, and at the pposite side of that the principal coal of the Gannister series is known at liviger and all round the northern part to Colne as the "mountain four eet," and it is there generally accompanied by an unusually large number f very fine specimens of Goniatites and other fossil remains.

Returning to the south-west side of the large fault, between Bacup and liviger, the Gannister coal, which was at Bacup 4 feet thick, becomes much inner in a westerly direction.

At Over Darwen the Gannister coal is called the "lower," "70 yards," or half-yard" bed. The principal seam above it is there known as the "yard oal," which, together with the "little coal" above it, corresponds with the 40-yards" seam. The flag and tile-rock of Darwen lies about 40 yards bove the "yard coal." The strata, about 10 yards in thickness, which se-arate the "little coal" from the "yard coal," at Darwen, gradually thin out n the direction of Hoddlesden. At the old Hoddlesden Colliery the two eams were found gradually approaching each other until they came so near s to be worked together; and now, where they are being worked, there is nly a division of black earth between, the rock being entirely nipped out. They continue together as one seam for some distance, but ultimately they livide out again, and at Belthorn the upper part is called the "half-yard," and the lower the "little coal." At Brookside and Duckworth Hall they again lie together, and are called the "Poor Robin" bed. At Chorley, and also at Heath Charnock, the corresponding coals are known as the "little" and the "higher mountain." At many of those places this "little" coal has a rock floor, which has often been mistaken for the true Gannister.

The total thickness of the strata between the Gannister coal and the Arley mine is, at Oldham, about 300 yards. At Simpson Clough it seems to be thinner than at any other point, being only about 253 yards. At Clayton, the distance is about 308 yards from the Arley to the Gannister. Adding to this the total thickness of strata in which coal-seams are found below the Gannister, namely, 326 yards, as shown at Mossley and Harts-head, gives a total thickness of about 625 yards of coal-bearing strata in he lower or Gannister series alone.

The middle series, from the Arley mine to the Worsley four-feet, is about 75 yards in thickness. The upper series, above the Worsley four-feet, as been proved at Patricroft to a thickness of 390 yards, but this is not e whole of it, and including the measures at Clayton, near Manchester, is about 550 yards in thickness. The total thickness of coal-measures the upper, middle, and lower series, to the lowest coal-seam, is therefore out 2150 yards, exclusive of the grits and limestone shales below.

In the middle series there are a large number of seams, and the field is divided into many divisions by main faults—the largest extending to a thousand yards of vertical displacement or throw.

The part known as the Burnley coal-field is not a detached portion, as is sometimes supposed and laid down on maps, but is connected with the main field by the lower strata up to the Gannister coal. The southern boundary, of what may still for convenience be termed the Burnley coal-field, is a remarkable fault, which runs nearly due east and west instead of north-west, like nearly all the other principal faults. At the eastern end this fault crosses the valley between Calder Head and Holme; it then passes Thieveley, where it has been worked for lead ore; then on to Burnt Hills, near Clawe Bridge, where lead ore has also been found in it, and also at Cupola, a name derived from the furnace formerly used for smelting the ore which was then worked. The fault then continues westwards through the town of Church to the south of Rishton. For the most part of its course it consists of two faults, which are sometimes near together and sometimes run from 500 to 700 yards apart. The northern one is a downthrow to the south of about 70 yards, and the southern one a downthrow to the north of about 250 yards, forming a trough or deep belt between. The two faults taken together may be looked upon as a great anticlinal division. The strata on the south side dip for the most part at a slight angle southwards into the main coal-field; and on the north side they dip to the north, forming the Burnley coal-field.

The contour of the Burnley coal-field forms nearly half a basin. The north-western outcrop is very steep, the dip being nearly at an angle of 45°, and is called the "rearers." Like other parts of the Lancashire coal-field, the Burnley basin is divided by large faults, most of which have a direction 35° west of true north. By these faults it is divided into six separate main divisions, in each of which the Arley four-feet coal has been found near the centre.

In the Altham basin, the Hapton basin, and in the Habergham basin, the Arley mine is worked.

In the fifth, or Burnley basin of the Burnley coal-field, the Arley mine extends over a large area. It is there where the greatest depth of strata in the Burnley basin are found.

Sixth, and last, is the Marsden basin, where the Arley mine is also worked. This basin extends to near Colne, where the mountain four-feet is now being worked. The bedding of the strata in these six divisions of the Burnley coal-field is more laminated, or flaggy, than at most other parts of the Lancashire coal-field.

At Clayton and Bradford, on the east side of the city of Manchester, the coal strata are apparently surrounded by "red rock," which disconnects the upper coal-seams from those at Pendleton and other places.

At Patricroft, and Bedford, near Leigh, thin limestones are also met with; but they are not stratified with the coal-measures, and are classed with "red-rock" (Permian) strata, which here overlie the coal-measures.

The paper is illustrated by a remarkably fine section of the beds, more than 6 feet in length, giving the name and thickness of every stratum and seam.

Another paper was read "On some horses' teeth, and a supposed worked flint found in the drift at Barrowford, near Burnley," by Mr. J. Whitaker. In the wider parts of the valley the Boulder clay is covered by three or four yards of gravel, on the top of which lies sand about two feet thick, covered by three feet of fine sandy soil, the whole resting on the millstone-grit series of rocks. The teeth were found during the cutting of a trench ross the widest part of the valley, and were embedded in the gravel, six et below the surface. They belong to the genus *Equus*. The flint was icked out from amongst the materials thrown out of the trench.

Geological Society.—*May 20th*, 1863.—1. "Further Observations on ie Devonian Plants of Maine, Gaspé, and New York." By J. W. awson, LL.D., F.R.S., F.G.S.

Since the preparation of his paper on the Devonian Flora of North-astern America, published in the Society's Journal, vol. xviii. pp. 296 *seq.*, the author has been enabled to explore more thoroughly than be-re the plant-bearing beds of Perry, in Maine, Gaspé, and New York. The sults of these further explorations, together with descriptions of the new ecies of plants discovered, were given in this paper; as also were some ew and important facts respecting the distribution of the Devonian rocks f the State of New York, which give to several of the plants from that gion a somewhat older geological position than that heretofore assigned them.

2. "Notice of a New Species of *Dendrerpeton*, and of the Dermal Cover-igs of certain Carboniferous Reptiles." By J. W. Dawson, LL.D., F.R.S.

This paper referred to new facts ascertained in the course of a re-exami-ation of the remains of reptiles from the Coal-formation of Nova Scotia, nd first to the characters of a new and smaller species of *Dendrerpeton*, r which Dr. Dawson proposed the name of *D. Oweni*. The author then escribed the remains of skin and horny scales which he had lately dis-overed, and which he supposed to belong to *Dendrerpeton Oweni*, *Hylo-omus Wymani*, and *H. Lyelli*. He also gave restorations of these ani-nals, according to what he regarded as the more probable arrangement of he parts; and, after expressing his belief that *Hylonomus* may have acertian affinities, he stated that should they prove to be really Batra-hian, a new Order must be created for their reception, many of the haracters of which would coincide with those of the humbler tribes of izards.

3. "On the Upper Old Red Sandstone and the Upper Devonian Rocks." By J. W. Salter, Esq., F.G.S., A.L.S.

The conclusions arrived at by Mr. Salter were based upon certain sec-ions in Pembrokeshire, Devonshire, and the North and South of Ireland, which he described in full, and compared with one another as well as with he Upper Devonian of the Continent and America, giving lists of fossils rom the English localities. The sections in Devonshire and South Ire-and were contrasted with those in Pembrokeshire and North Ireland; nd it was shown that, although the physical features in the two cases ery nearly correspond, the Marwood series is constant, and the Pilton roup of the former districts is a series unknown in Pembrokeshire, or nly represented by beds, a few feet thick, at the base of the Carboniferous late. The author endeavoured further to prove the intercalation of narine beds in the Upper Old Red Sandstone, and, by the fossils, the cor-elation of the Marwood group of Devonshire with the uppermost part of hat series. He stated his belief in Sir R. I. Murchison's suggestion, that he Caithness Flags belong to the Middle, and the Cephalaspis Beds of Scotland to the Lower Old Red, which divisions he considered equivalent o the Middle and Lower Devonian respectively; and concluded by assign-ng the Tilestones (or Ledbury shales) to the Lowest Devonian.

June 3rd.—"On the Section at Moulin-Quignon, and on the peculiar haracter of some of the Flint Implements found there." By J. Prest-ich, Esq., F.R.S., F.G.S.

The recent discovery of a human jaw and of flint implements of a peculiar type and fresh appearance at Moulin-Quignon has led to questions having been lately raised as to the age of the gravel-beds, and the antiquity of these remains. Mr. Prestwich showed how conflicting had been the evidence in support of the views formerly entertained, and dwelt upon the appearances which had raised the doubts as to the genuineness of certain implements and the fossil nature of the jaw. He also gave a *résumé* of the proceedings of the conference lately held at Paris and Abbeville, and remarked that the intrinsic evidence appeared to prove the spurious nature of the objects, while the evidence derived from the study of the beds had led to the opposite conclusion.

The author then showed that, from the physical configuration of the district, corroborated by the presence of extinct mammalia distinctly of contemporaneous age, the modern age assigned to these beds by some geologists could not be maintained; and that, from the occurrence of freshwater shells in both the high- and low-level gravels, their formation must have been due to river-action, and not to a wave of translation or other modification of marine action.

Mr. Prestwich concluded by stating that, whatever may be the conclusions drawn from the jaw and the flint-implements, the age of the deposits is to him perfectly well determined as being of the early quaternary or post-pliocene period, older than the Menchecourt gravels, and anterior to the excavation of the valley of the Somme; and as some flint-implements, the genuineness of which is not doubted, have been found in these deposits, the question of the antiquity of man will not be affected, whatever the conclusions arrived at with regard to certain others.

The following specimens were presented:—

Cretaceous fossils from Ras Fartak, on the south-east coast of Arabia; fossils from the Somali Mountains, collected by Messrs. Burton and Speke; fossils from the north bank of the river Nerbudda; and Tertiary fossils from Travancore, by Dr. H. J. Carter, F.R.S; fossils from the Valley of Kelat, by Dr. Cook, of H.M. Bombay Army.

NOTES AND QUERIES.

New Ossiferous Cavern.—Sir Lawrance Palk, Bart., M.P., has placed a limestone cavern, recently discovered on his property at Torquay, under the care of Mr. Pengelly, who has undertaken to explore it.

[Bones are numerous, and the highest interest will undoubtedly attach to the results of the exploration in Mr. Pengelly's able hands.—Ed. Geol.]

Roots of Lepidodendron.—At page 107 of the April number of the 'Geologist' for the year 1861, which has just fallen into my hands, it is there stated by Mr. Salter, in his lecture on Coal, that he believes Halonia to be the root of Lepidodendron. I have had in my possession for about three years a good specimen of Lepidodendron, with roots of Halonia attached, which puts the matter beyond a doubt. It may also be pleasing to those geologists to inform them that I shall take an especial interest in showing it.—James Wild.

Pleasant Spring, Red Tan Nook, Oldham, May 30th, 1863.

The Reptiles of the Chalk.—The reptiles of the Chalk, although they are not so abundant or so varied in that formation as reptilia are both in forms and numbers in the Liassic and Oolitic beds, nor so grand,

DOLICHOSAURUS LONGICOLLIS.

From the Lower Chalk of Burham, Kent.

[In the Collection of Mrs. Smith, of Tunbridge Wells.]

S. J. Mackie del.

perhaps, as those of the Wealden age, are nevertheless an extraordinary class amongst the fossils of that later period.

Of Chelonians, we have the beautifully-preserved *Chelone Benstedi*, exhibiting the whole of the carapace and a considerable portion of the plastron; but although we have the body, nobody, as far as I know, has ever found the head of this or any other Chalk-turtle. As we may infer that turtles in those times were not headless, we may hope that collectors in Chalk districts will use their endeavours to find some of the heads our Chalk-turtles have lost.

Besides the *Chelone Benstedi*, there have been found in the Chalk, portions of the large species of turtle recorded by Camper as occurring in the Maestricht beds,—the *Chelone Camperi* of Owen. Indeterminate fragments of other species have been also noted in Professor Owen's 'Memoir.'

Of the Lacertilia, we have from the Lower Chalk of Cambridge, Maidstone, and Northfleet, the *Raphiosaurus subulidens* (*R. lucius* of Dixon); the *Coniosaurus crassidens*, from Clayton, Worthing, and Charing, and the railway cutting between Brighton and Lewes; the *Dolichosaurus longicollis*, from Burham, a strange, small, wonderfully long, thin form, of which only one specimen is known, one head and upper moiety being in the collection of Mrs. Smith, of Tunbridge Wells, and a second portion, containing the posterior, abdominal, and sacral vertebræ, with portions of the hinder limbs, in the collection of Sir Philip Egerton.

Then of the swimming lizards we have the great Mosasaurus, some species attaining a length of 25 feet, a genus made ever famous by the Canon Goddin's specimen, captured by the French at the siege of Maestricht. The British chalk-beds have yielded various portions of *M. gracilis*, chiefly from Sussex and Kent. Another mosasauroid form, the *Leiodon anceps*, has been found in a chalk-pit in Essex and in the Brighton railway-cutting near Lewes.

Of crocodiles, the English chalk—for it is of this English chalk we are now solely speaking—has yielded *Polyptychodon interruptus* in the Chalk-marl; *P. continuus*, Lower Chalk; *Plesiosaurus Bernardi* in the Lower Chalk of Dover; *P. constrictus*, from Steyning, in Sussex; and some other remains, possibly of other species, in the Chalk of Kent and Sussex; *Ichthyosaurus campylodon*, from the cuttings in the Grey Chalk for the Dover Railway, and from the Upper Greensand of Cambridge.

Of the strange Order Pterosauria, or winged reptiles, abundant remains have been found in the Kentish chalk, chiefly at Burham, on the hillside of the Medway valley. The nature of these remains was first established by Dr. Bowerbank, for previously they had been more or less doubtfully assigned to birds. A large fossil wing-bone of *Pterodactylus giganteus*, from the Middle Chalk of that locality,—sometimes erroneously referred to as that of an albatross,—was figured, in 1845, in the Proceedings of the Geological Society by him; and in the same paper, characteristic jaws and teeth, and various bones of other species were briefly noticed.

The expanse of wing of this Pterodactyle was estimated, from the proportions of Goldfuss' *P. crassirostris*, at least 9 feet. Another gigantic flying reptile, *P. Cuvieri*, was exhibited by the same geologist before the Zoological Society in 1851. The specimen was a portion of jaw without any traces of nasal perforations, 7 inches in length; and Professor Owen estimates the entire skull at close upon $2\frac{1}{2}$ feet in length. The *P. conirostris* of Owen, in Dixon's 'Geology of Sussex,' is a synonym of Bowerbank's *P. giganteus*. Another species, from the Middle Chalk of Kent, also in Dr. Bowerbank's collection, has been described by Professor Owen, —*P. compressirostris*.

The great Dinosaurian lizards have not been met with higher than the Greensand beds,—unless a large undetermined bone in the Folkestone Town Collection, collected by the author, should prove to belong to some great Iguanodon.

To these notes which we have made in the hope of drawing the attention of collectors, at this genial season, and of gathering information of new or unrecorded specimens, in private cabinets and local museums, we may usefully add a record of the specimens in the British Museum. These are in the table-cases:—Femur of *Trionyx ?*, from the Chalk of Rochester, collected by Mr. Bensted (and figured in 'Geologist,' Vol. V. p. 296); two large teeth of *Polyptychodon ?*, with fragments of cellular bone, from the Grey Chalk of Dover? ; jaws, loose teeth, humerus, vertebræ, wing, and bones of Pterodactyles, from Upper Greensand of Cambridge; and a portion of very large wing-bone of Pterodactyle, from the Gault of Folkestone; beaks and other bones of *Chelone altimentum*, *Chelone depressimentum*, and possibly of other Chelonians, from the Upper Greensand of Cambridge; very fragmentary tooth, without the enamel, of perhaps *Pliosaurus ?*, from the Lower Chalk of Sussex (Mantell Collection); teeth of species of Plesiosaurus, from the White Chalk of Southerham, Sussex, and the Wealden of Tilgate Forest; teeth of *Ichthyosaurus campylodon*, from the Chalk of Islesham, and Lower Grey Chalk of Dover; also some from the Gault of Folkestone, and Upper Greensand of Cambridge, from which last deposit are also some worn vertebræ; teeth of *Polyptychodon interruptus*, from the Sussex White Chalk (Dixon Collection), the White Chalk of Rochester, Kent; from Steyning, in Sussex (Mantell Collection); (? sp.) two specimens in hard chalk, from Kent (Taylor Collection); (? sp.) from the Folkestone Gault; and numerous teeth from the Upper Greensand of Cambridge. From the Wealden, *Suchosaurus cultridens*, Owen, Tilgate Forest (Mantell Collection); *Goniopholis crassidens*, Owen, Tilgate Forest, Sussex (Mantell Collection); *Coniosaurus*— jaw and isolated teeth of *C. crassidens*, Owen, from the Chalk of Washington, near Worthing (Dixon Coll.). In the Saurian wall-cases are fine jaws with teeth and large vertebræ of *Ichthyosaurus campylodon*, Carter, from the Grey Chalk of the Round Down Tunnel, on the South-Eastern Railway, near Dover; and teeth and vertebræ of *Icthyosaurus campylodon ?*, from the Cambridge Upper Greensand; vertebræ of a Wealden *Plesiosaurus* in sandstone from Tilgate Forest (Mantell Coll.).

Of Chelonians in the wall-cases are the fine remains of *Chelone Benstedi*, found in the Lower Chalk of Burham by Mr. Bensted, and given by him to Dr. Mantell, and some fragments from the Chalk of Lewes and Rochester; numerous remains of *Chelone Mantelli*, from the Wealden of Tilgate Forest (Mantell Coll.); and of *Platemys Dixoni*, Owen, from the same locality (Mantell Coll.).

Of the Great Lacertians in the wall-cases are a fine fragment of upper and lower jaws, with teeth, of *Mosasaurus gracilis*, Owen, from the Lower Chalk of Burham (Taylor Coll.); two vertebræ of the same species from the Upper (?) Chalk of Lewes; and isolated teeth of Mosasaurus (sp. ?) from the Norwich Chalk (Mantell Coll.); and the Egerton specimen of *Dolichosaurus longicollis*, from the Grey (not Lower White) Chalk of Kent.

We would here only add that the species of which, more than any other, it is particularly desirable to get further evidence, both as to its nature, size, and geological zone, is the *Dolichosaurus longicollis*, of the specimen of which in Mrs. Smith's collection we give a figure in Plate XIV.

S. J. Mackie.

The Mines of Tuscany.—The working of mines in Tuscany dates from the earliest antiquity, having exercised an important influence on the history and social economy of the ancient Etruscan people; and evidence of ancient workings, assignable to Etruscan, Roman, and mediæval ages, have been often encountered in modern explorations. In the late International Exhibition, M. Hauft, of Florence, exhibited a series of plans and synoptical tables illustrating this subject. Amongst these were special plans, on a scale of three inches to a mile, showing that the mineral veins, fumerolas, brine-springs, and lines of volcanic activity, have a remarkable amount of parallelism, and form two great groups, the intersections of which are the chief seats of mining enterprise. This double parallelism has also been observed to exist in the mining region between the Apuan Alps and Mount Amiata. The average direction of the first group is N. 3° W.; the extremes lying between N. 28° W., and N. 11° E., or a total variation of 39°. The mean direction of the second group is N. 54° W.; the extremes N. 67° W., and N. 45° W., or 22° of variation. The direction of the brine-springs is N. 46° W., the variation being 7° on either side. The course of the deposits of alum worked at Montione and Frassine is similar to the salt group, viz. W. 50° E.; the fumaroles, whose vapours contain boracic acid, are arranged in four series, having a mean direction of N. 47° W., with a variation on either side of 5½°. Two other lines of fumaroles have a direction N. 12° E., which coincides with the strike of the four great deposits of iron ores existing in the island of Elba. The lines of strike passing the marble quarries near Seravezza, give directions N., and N. 53° W. The direction of a line passing the mines of Montieri, Gerfalco, and Poggio Matti, N. 48° W., or parallel to the line of the subterranean fires of Mount Oggioli, Pietramala, and Peglio. The directions of the three gigantic metalliferous lines of the district of Massa are N. 13° W., N. 11° W., and N. 3° W., while that of the deposit of alum at Accessa, Monterotondo, and Sasso is N. 7° W. All the above lines of bearing are included between the directions N. 28° W., and N. 12° E. in the one case; and between N. 67° W., and N. 46° W. in the other,—an amount of variation so small, that M. Hauft has concluded that in Tuscany the various metalliferous deposits, as well as those of alum and sulphur, the brine-springs, and the various volcanic emanations, are all different phases of one great formation, due to causes still in active operation in the production of borax, petroleum, sulphur, etc. This formation is, he says, divisible into two periods of unequal value, as far as minerals are concerned, for many of the veins contain no metalliferous substances, and it is only in a few of the metalliferous deposits of the Maremmana formation that silver ores occur. The above conclusion is verified, he considers, by other coincident circumstances. The two lines which unite the extreme points in the salt districts, and include the four principal series of boracic acid, *soffioni*, are parallel to one of the leading lines of mineral veins; the line passing through the fumaroles of Lucignano and Serrazzano, combines exactly with that uniting the saline springs of Fontebagni, Loriano, and Scornellina; while, in like manner, the line joining the fumaroles of Monterotondo and Sasso coincides with the line of salt-springs rising between Fattagliana and Prugnano. This relation between the most important borax districts and the metalliferous country of Tuscany has led to the supposition that they may be regarded as in some sort a continuation of the latter. In addition to these cases may be added the occurrence of borax and alum at Sasso and Monterotondo, and the association of alum deposits with mineral ores at Accessa, both of which are in direction N. 12° W. In the same manner, the fumaroles of the lake of Monterotondo correspond, on the line of N. 49° W. with the mines of Cugnano, and in the direction W. 3° E.

with the copper veins of Serrazzano. Throughout the whole of Tuscany the most productive mineral region is that of the borax lagoons. On the north-west portion of this area copper ores are found, occurring in veins of serpentine rocks. Further towards the south, mines of copper and argentiferous lead are worked, principally in the Macigno formation, which is also the chief repository of the borax. By thus tracing a series of lines through all the points at which minerals occur, M. Hauft claims to have established the limits and subdivisions of each district. In this way many gaps are seen to occur in some places, and these, M. Hauft thinks, indicate that many mineral mines must be still unknown, as, for instance, in the mountains of Lucca and Pisa; for the exploration of these unexamined districts, the application of the indications of other mineral zones should be of considerable utility, and it is reasonable to suppose that new deposits would be found in the prolongation of known areas, or in their immediate vicinity. In like manner it has been suggested that, by attention to this principle, aided by the records of history, the rediscovery of the old Etruscan mines may also be possible.

MAMMALIAN, CETACEAN, AND HUMAN REMAINS.—The following notes, made in reading various old authors, may prove interesting and useful in present investigations of mammalian, human, and other remains.—S. J. MACKIE.

From the NATURÆ GAZOPHYLACIO penes JOANNEM HIERONYMUM ZANNICHELLI. Venetiis. Index primus, quo Fossilia figurata recensentur. Venetiis, 1726.

Tabula quinta, p. 23 *et seq.*—

25. Dens Hippopotami fossilis, ex rivo dicto *della Salsa*, prope Saxolum, in ditione Mutinensi.

31. Ossa humana fossilia, ex ditione Palatina, in Germania.

42. Frustum mandibulæ Elephantis fossile, ex agro Romano.

*43. Lapis frumentarius, seu juxta Langium, semen fœniculi, ex agro Veronensi.

48. Unguis Bovis in lapidem concretus, ex monte prope Cenetiam.

Tabula octava, p. 43 *et seq.*—

27. Cornu Capræ fragmentum, simul cum ungula in saxo, ex ditione Cenetensi.

Tabula nona, p. 49 *et seq.*—

26. }
27. } Dentes Draconum, ex Saxonia.

Series altera, Fossilium figuratorum ingentis magnitudinis, p. 53 *et seq.*

3. Dens molaris minor Elephantis fossilis, ex agro Romano.

10. Costæ Balenæ fossilis frustum, ex montibus Norvegiæ.

52. Dens incisorius Elephantis, summæ duritiei, ex agro Romano.

58. Dens molaris maximus Elephantis, agri Romani.

133. Ungula Bovis fossilis, ex agro Cenetensi.

139. Dens Draconis, seu potius ingentis Ceti, ex monte Carpatio.

148. Ungula Bovis minor fossilis, ex Cenetensi agro.

155. Dentes cujusdam animalis terrestris, saxo rubiginosi coloris incerti, ex Dalmatia.

*169. ? Lapis piriformis, ex agro Veronensi.

194. Calvaria Hominis cum suis dentibus, una cum osse humeri, fossilis et in lapidem concreta, ex ditione Istriæ.

202. Linguæ Bubulæ fossiles, ex specu Behumaniana, seu potius dentes minores Elephantum.

Sunt et alia quamplurima, omissa in hoc indice, imposterum tamen, cum opportunum videbitur, addenda.

* Can this be possibly a large flint-implement ?—ED. GEOL.

Iany of these entries are repeated in the latter catalogue of Zannichelli's ection, entitled—

ɪNUMERATIO RERUM NATURALIUM quæ in Musæo Zannichelliano asser-tur. Venetiis, 1736.

Iusæi Zannichelliani abacus alter (p. 30 *et seq.*), in quo fossilia figurata tinentur.

. Dens molaris minor Elephanti fossilis, ex agro Romano.
0. Costæ Balenæ fossilis frustum, ex montibus Norvegiæ.
2. Dens incisorius Elephanti, summæ duritiei, ex agro Romano.
8. Dens molaris maximus Elephanti, agri Romani.
8. Musculus lapideus aliisque Crustaceis minoribus unitus, ex agro ronensi.
33. Ungula Bovis fossilis, ex agro Cenetensi.
39. Dens Draconis, seu potius ingentis Ceti, ex monte Carpatio.
48. Ungula Bovis minor fossilis, ex Cenetensi agro.
55. Dentes cujusdam animalis terrestris, saxo rubiginosi coloris incerti, Dalmatia.
94. Calvaria Hominis cum suis dentibus, una cum osse humeri, fos-s et in lapidem concreta, ex ditione Istriæ.
02. Linguæ Bubulæ fossiles, ex specu Behumaniana, seu potius dentes iores Elephantorum.
08. Dens maximus Elephanti fossilis, optimè conservatus.

'ossilia figurata in abaci inferiore parte reposita (p. 51 *et seq.*).

Tabula quinta.—

5. Dens Hippopotami fossilis, ex rivo dicto *Salsa*, prope Saxolum, in one Mutinensi.
1. Ossa humana fossilia, ex ditione Palatina, in Germania.
2. Frustum mandibulæ Elephanti fossile, ex agro Romano.
8. Unguis Bovis in lapidem concretus, ex monte prope Cenetam.

Tabula octava, p. 87 *et seq.*—

2. Ungula Hircina, in lapidem concreta, ex Cenetensi ditione.

Tabula nona, p. 93 *et seq.*—

6. }
7. } Dentes Draconum, ex Saxonia.

GEOLOGY OF THE GOLD-FIELDS OF AUCKLAND, NEW ZEALAND.—Dr. Lauder Lindsay, who made a geological examination of the Coro-ndel gold-field, in the province of Auckland, in February, describes romandel as a different type of gold-field from Tuapeka (Otago), and, such, of interest as illustrative of the general geology of the New land gold-fields. The main results of his observations and deductions y be concisely stated thus:—

The geology of the northern gold-fields of New Zealand, including those Nelson as well as Auckland, does not differ essentially from that of the thern or Otago gold-fields (the geology of the latter is described in this ume, p. 143). The parent slates, for instance, are in the north more quently of a clay-slate or argillaceous character than in the south; the iferous quartzites are frequently developed to an extent as yet unknown Otago; the evidences of trappean disturbance are more numerous, and metamorphism of the slates by the contiguity of the erupted or in-ded traps better marked. Nor does the character of the gold differ terially, save in so far as, in certain localities, it is more generally asso-ted with its quartz matrix.

The Coromandel peninsula consists mainly of a mountain ridge, running arly north and south; the mountains having a bold serrated outline, and rying in height from 1000 to 2000 feet. The valleys between the spurs given off laterally by this main or dividing range are of the character generally of ravines or gorges, occupied by mere mountain-streams; the "flats" or alluvial tracts at their mouths, and on the coast, are inconsiderable.

This mountain-range consists apparently of slates of Silurian age, generally of argillaceous character, but greatly altered by contact with, or proximity to, numerous outbursts or intrusions of trappean and other rocks. The mountains are so densely wooded, and so difficult of access, that it is only here and there in the gorges of the streams that sections of these slates may be examined. In these sections the slates are frequently found to resemble Lydian stone or the slaty varieties of basalt, such as clinkstone; while they are disposed more or less vertically, their irregular upturned edges affording the most convenient and abundant "pockets" for the detention and storage of the alluvial gold washed from the higher grounds.

Local geologists describe the fundamental rock of the Coromandel mountain-system as granitic, and the granite as forming here and there the "aiguilles" of the dividing ridge; but Dr. Lindsay met with no granite *in situ*, nor did he discover granitic boulders or pebbles in the boulder-clays of the auriferous drift, nor in the shingly beds of the mountain streams about Coromandel Harbour.

The Coromandel slates are characterized by their prominent and numerous quartz "reefs," consisting of auriferous quartzites. Here and there, where the dense vegetation admits, these reefs are met with *in situ*, frequently as "dykes," standing prominently above the general level of the slates; sometimes forming the top of the dividing ridge itself. The proximity and abundance of such quartzites are sufficiently indicated by the immense numbers of huge quartz-boulders or blocks which bestrew the low ground, and occupy the ravines and gorges; which blocks are characterized by comparative angularity. The quartz is frequently of the porous, light, spongy character so prevalent in the gold-fields of Australia, Nova Scotia, California, and other auriferous countries; and its colour is frequently buff, brown, ochrey, or vermilion, the result, apparently, of different degrees of ferruginous impregnation.

The auriferous drift is mostly of the character of the newer or upper Tertiary drifts of the Otago gold-fields, consisting essentially of—*a*, variously-coloured clays; *b*, boulder-clays, also variously coloured; and *c*, gravels, of the "chopped slate" character, the débris of the component rocks of the parent ranges, which gravels rest immediately on the "bed-rock" or slate. In this gravel, as at Otago, the gold chiefly occurs; hence to these gravels are, as yet, mainly directed the operations of the miner. The gold itself occurs in the form of dust, scales, or nuggets—frequently as scaly nuggets or "pepites," but still more generally dendritically disseminated in quartz-pebbles, which are usually ochrey or brownish in colour. It is largely associated with iserine (titaniferous iron-sand), apparently of the character of that so abundant at Taranaki. This mineral, indeed, appears to be associated with gold in almost all the New Zealand gold-fields.

The prevalent volcanic rocks, which burst through, overlie, or are otherwise associated with the slates, are mainly various trachytes, tuffs, basalts, and syenites. A hard breccia, consisting to a great extent of fragments of jasper and flint, resembling somewhat the "cement" or quartz conglomerate of the older or lower Tertiary auriferous drifts of the Otago gold-fields, occurs on Beeson's Island, in Coromandel Harbour, which island is mainly or altogether tufaceous. Boulders of basalt and syenite bestrew the tops the hills which form the greater part of the said island; and basaltic ulders are associated with quartzose ones in the shingly beds of the untain streams of Coromandel and in the boulder-clays of the auriferous ft.

Contrasting the Tuapeka (Otago) with the Coromandel gold-fields, the hor indicates the following respective peculiarities:—At Tuapeka tago):—*a*. The bare open country, resembling the Lammermuirs of otland, consisting of gently undulating "ranges," of a height generally from 500 to 1500 feet. *b*. The abundance of the auriferous drift, and comparative insignificance or scarcity of the parent quartzites. *c*. The rcity of timber for fuel and slabbing; but, on the other hand, the pre- ice of lignites. *d*. The inclement climate. *e*. The difficulties of land- nmunication with the capital, Dunedin, arising from insufficient roads. Unlimited powers of "prospecting" and "working," arising from the sence of a native population. At Coromandel:—*a*. The precipitous untain-ranges, densely covered with a jungle-vegetation to the top; the l-bases impinging directly on the sea-margin, without the intervention "flats," save to an insignificant extent. *b*. The scarcity of the aurifer- s drifts, and the abundance of the parent quartzites. *c*. The abundance timber for fuel, mining-works, and dwellings. *d*. The superior climate, ising from its geographical position, 800 miles more northerly. *e*. The ilities of water-communication with the capital, Auckland, 45 or 50 les distant. *f*. Difficulties and dangers of prospecting and working, ising from the presence of a jealous, hostile proprietary native popu- tion.

From his observations at Coromandel and Tuapeka, as well as in the her parts of New Zealand visited during his tour of 1861–62, Dr. Lindsay akes the following statements, inferences, or predictions:—

1. That while there is, at Coromandel, a very limited and insignificant eld for *alluvial digging*, there is ample scope for *quartz-mining*. 2. That e auriferous resources of Coromandel will only be fully developed in the urse of many years by the application of all modern improvements in emistry and mechanics to *systematic mining*, which must become one of e permanent industrial occupations of the province of Auckland, and hich will demand the sinking of a large capital in the first instance. That slates similar to those of Coromandel, with associated auriferous artzites, will be found to occur over a comparatively large area of the ovince of Auckland. 4. That new gold-fields remain to be discovered that province; though experiment only, and on a suitable scale, can termine where and whether "payable" gold-fields exist. 5. That where- *lignites* are widely distributed over the province of Auckland, it is most sirable to ascertain whether they are of similar geological age to those Otago, and associated with the same auriferous drifts. 6. That whereas, Australia and other auriferous countries, gold is not confined necessarily metamorphic slates or their derived drifts, but occurs occasionally in anitic and hornblendic (syenitic) rocks or their débris; and whereas, ough this is rare in New Zealand, there is, according to the testimony of r. Haast, the Government geologist of the Canterbury province, at least e good instance of such an occurrence in the province of Nelson, in the ds of the rivers Roto-iti and Roto-roa, where the gold could apparently ly have been derived from the decomposition or degradation of rocks of syenitic or hornblendic character,—the attention of prospectors and ners, not only in the province of Auckland, but in that of Otago, and, leed, in all the New Zealand provinces, all of which will probably be ind to be to a greater or less extent auriferous, should be directed to

drifts derived from granitic and hornblendic rocks, as well as to those resulting from the detrition of Silurian and other slates. 7. That it is probable the auriferous system of rocks, the supposed Silurian slates, extends from the province of Otago into the adjacent provinces of Southland and Canterbury; from Nelson, where they are already known to exist to an extent second only to that in Otago, and where, indeed, "gold-fields" have been successfully worked for a considerably longer period, in Canterbury; and from Auckland into Wellington and adjacent districts, though to what extent remains to be determined by actual survey and experiment. 8. Contrasting the Northern with the Middle Island of New Zealand, it is probable that the latter is more extensively and largely auriferous than the former; that in the former the auriferous quartzites are developed out of proportion to the derived drifts, while in the latter the reverse is the case; and that, should this supposition prove to be correct, the character of the gold-mining in the two islands will necessary differ most materially. 9. Speaking in general terms, auriferous rocks may be said to extend throughout the New Zealand islands, the exceptions being where they are interrupted by recent volcanic formations, traps of various ages, mostly Tertiary, limestones of various ages, extensive Tertiary beds, and other geological series or systems.

Dr. Lindsay strongly advocates an immediate systematic *geological survey* of the province of Auckland, estimating its duration at about five years, with an expenditure on staff, travelling, and publications of about £10,000. He recommends this equally for all the New Zealand provinces of which geological surveys have not yet been made; pointing to the example of Otago, which has recently appointed a Government geologist, who is now engaged on a three years' survey of that most interesting province.

Wren's Section at St. Paul's.—The account of the geological section presented in the excavation of the foundations of St. Paul's may be worth a record here. It is from 'The Parentalia,' published by Sir Christopher Wren's son, in 1750:—

"It has been before observed that the graves of several ages and fashions, in strata or layers of earth one above another, particularly at the north side of St. Paul's, manifestly showed a great antiquity from the British and Roman times, by the means whereof the ground had been raised; but, upon searching for the natural ground below these graves, the surveyor observed that the foundation of the old church stood upon a layer of very close and hard pot-earth, and concluded that the same ground which had borne so weighty a building might reasonably be trusted again. However, he had the curiosity to search further, and accordingly dug wells in several places, and discovered the hard pot-earth to be, on the north side of the churchyard, about six feet thick and more, but thinner and thinner towards the south, till it was, upon the declining of the hill, scarce four feet; still he searched lower, and found nothing but dry sand, mixed sometimes unequally, but loose, so that it would run through the fingers. He went on till he came to water and sand, mixed with periwinkles and other sea-shells: these were about the level of low-water mark. He continued boring till he came to hard beach, and still under that till he came to the natural hard clay which lies under the city and country, and Thames also, far and wide. By these shells it was evident the sea had been where now the hill is on which Paul's stands. The surveyor was of opinion the whole country between Camberwell hill and the hills of Essex might have been a great frith or sinus of the sea, and much wider near the mouth of the Thames, which made a large plain of sand at low-water, rough which the river found its way; but at low-water, as often as it ıppened in summer-weather, when the sun dried the surface of the sand ıd a strong wind happened at the same time, before the flood came on, e sand would drive with the wind and raise heaps, and in time large ıd lofty sand-hills; for so are the sand-hills raised upon the opposite coasts ' Flanders and Holland. The sands, upon such a conjuncture of sunshine ıd wind, drive in visible clouds; this might be the effect of many ages :fore history, and yet without having recourse to the flood. This ighty broad sand (now good meadow) was restrained by large banks ill remaining, and reducing the river to its channel; a great work, of hich history gives no account. The Britons were too rude to attempt it; ıe Saxons too much busied with continued wars; he therefore concluded was a Roman work: one little breach in his time cost £7000 to restore. he sand-hill at Paul's, in the time of the Roman colony, was about twelve et lower than now it is; and the finer sand, easier driving with the ind, lay uppermost, and the hard coat of pot-earth might then be made; r pot-earth, dissolved in water and viewed by a microscope, is but imlpable fine sand, which with fire will vitrify; and of this earth upon the lace were those urns, sacrificing vessels, and other pottery-ware made, hich, as noted before, were found here in great abundance, more espeially towards the north-east of the ground.

"In the progress of the works of the foundations the surveyor met with ne unexpected difficulty. He began to dig the foundations from the rest end, and had proceeded successfully through the dome to the east nd, where the brick-earth bottom was yet very good; but as he went on o the north-east corner, which was the last, and where nothing was exected to interrupt, he fell, in prosecuting the design, upon a pit where all he pot-earth had been robbed by the potters of old time. Here were disovered quantities of urns, broken vessels, and pottery-ware of divers orts and shapes. How far this pit extended northward there was no ocasion to examine: no ox-skulls, horns of stags, tusks of boars, were found o corroborate the accounts of Stow, Camden, and others; nor any founlations more eastward. If there was formerly a temple to Diana, he supposed it might have been within the walls of the colony, and more to the outh. It was no little perplexity to fall in this at last; he wanted but ix or seven feet to compleat the design, and this fell in the very angle ıorth-east; he knew very well that under the layer of pot-earth there was ıo other good ground to be found till he came to the low-water mark of he Thames, at least forty feet lower. His artificers proposed to him to ile, which he refused; for though piles may last for ever when always in rater (otherwise London Bridge would fall), yet if they are driven through lry sand, though sometimes moist, they will rot: his endeavours were to uild for eternity. He therefore sunk a pit of eighteen feet square, wharfng up the sand with timber, till he came, forty feet lower, into water and ea-shells, where there was a firm sea-beach, which confirmed what was efore asserted, that the sea had been, in ages past, where now Paul's is. Ie bored through this beach till he came to the original clay; being then atisfied, he began from the beach a square pier of solid good masonry, ten eet square, till he came within fifteen feet of the present ground, then he urned a short arch underground to the former foundation, which was roken off by the untoward accident of the pit. Thus the north-east coin f the quire stands very firm, and no doubt will stand."—(From 'Parentalia; ·, Memoirs of the Family of the Wrens,' pp. 285, 286. By Christopher Vren, son of Sir Christopher Wren, late Surveyor-General of Royal uildings. London: 1750.)

MISCELLANEOUS NOTICES.

The 'Dublin Quarterly Journal of Science' for April (No. 10) contains papers "On the Granite Rocks of Donegal, and the Minerals associated therewith;" and "On the Mineral Localities of Donegal, as ascertained by Sir Charles Giesecke and by the British Association Committee, 1861-2," by Mr. Robert H. Scott; "Sketch of the Geology of the District of Shorapoor, or Soorpoor, in the Dekhan," by Captain Meadows Taylor, with three plates; "On the Geology of Parts of Sligo, etc.," by Mr. H. B. Wynne, F.G.S., with a plate and a list of fossils collected; "A Sketch of the Geological Structure of Finland, by H. J. Holmberg, of Helsingfors. The other geological papers which have appeared during the present year in the former number of this excellent journal, are, "Notes on the Geology of the East Coast of China," by Thomas W. Kingmill; "The Dhurmsalla Aerolith," by the Deputy Commissioner; "Note on the way in which the Calamine occurs at Silvermines, Co. Tipperary," by Mr. J. Beete Jukes.

The May number of 'Silliman's Journal' contains with, as usual, other highly valuable articles, papers "On American Devonian," and "On the Flora of the Devonian Period in North-Eastern America," by Dr. J. W. Dawson; On the Glacial Origin of certain Lakes in Switzerland, the Black Forest, Great Britain, Sweden, North America, and elsewhere," by Professor A. C. Ramsay, F.R.S.; "On some Questions concerning the Coal-formation of North America," by Mr. Leo. Lesquereux, being "Concluding Remarks on the Fossil Ferns," and remarks on "Calamitariæ;" and "Observations upon some of the Brachiopoda with reference to the genera Cryptonella, Centronella, Meristella, and Allied Forms," by Professor James Hall.

REVIEWS.

Natural Phenomena, the Genetic Record, and the Sciences, Harmonically Arranged and Compared. By Alexander M'Donald. London: Longman and Co. Sheffield: J. Pearce. 1863.

It would undoubtedly pass the ability of most critics to give a righteous verdict on this little book. We are by no means sure we should succeed in the task if we tried. It is the hardest reading we ever had; we will not say it is the driest. Its objects are evident.

"The thoughtful mind," the author begins in his Preface, "when pausing to consider why so many members of the Christian community should be so excited whenever Biblical statements are tested, is apt to assign various reasons as the cause. One is the fear of beholding a brother weaker in faith led astray; another is the secret urgings of vanity, causing fools to decide upon what they have not toiled nor striven to acquire; and last, though not least, is that wavering uncertainty to which the human mind is so liable during this our preparatory stage.

"We have reason given us, and allowed its use consonant to the range of our abilities. It is, therefore, the duty of each person to inquire concerning the truth of the Bible, although it may be beyond the reach of his mental power to conclusively grasp the whole."

So too the book opens very well—"Infinite and inexhaustible as nature appears to the investigator, the idea is continuously recurring that the laws which regulate the forces abounding thoughout the universe, are capable of being reduced within an extremely limited compass, and recognized as effects evolved from a few simple decrees, the ideal offspring of a superior intelligence." Even in the first sectional paragraph, however, the author shows his tendency to break off into that overweening word-picked style which puts the mind on a continual rack to comprehend his meaning, and will cause a painful feeling of labour and fatigue in ordinary readers.

"Similar," he continues, "to the notes which regulate our musical combinations, so do the nature forces appear to the imagination of the truthful inquirer, who desires and seeks a cause for the various modes of cohesion, interfusion, and repulsion. As thought dates backwards and endeavours to simplify its ideas it seems extremely probable that like the first simple arrangement of our musical notation, so are the prime cosmical actions capable of being arranged. A few points are taken where power becomes force, and motal progression is generated and evolved."

This, however, is very mild compared with the following, which occurs at page 123, and is only a fair sample of what meets the eye wherever we open the book:—

"Contemplatively pausing awhile, and reducing all sensuous perceptions within the limits of rest and motion, and viewing these under the terms electricity and magnetism, the bounds of knowledge may be still more tersely and clearly defined. Assuming electricity to be rest, rest as unitedly one is imperceptible, and is therefore a something apart from the perceptive electricity of science, which depends upon differential actions within this same vivic fluid or electricity; because to induce an electrically perceptive state there must be an opposition equal in power but different in balanced gradation to that which a certain subject has assumed," etc.

Or we may take the description of an atom at page 180:—

"The atom, then, is individually a rigid atomic tetraedron capable of quadrate conic balance, so as to remain and continue stationary within the gravitating action of a sphere. Likewise, that although rigid radiation is the rule of its form, it can be divided into three distinct classes, for which the terms radiate, ovate and cordate are appropriate; the heading of these classes being oxygen, nitrogen, and hydrogen. These again disclose to us the how and why of chemical and mechanical assumption, and the theoretical principles of colour, sound, and heat; colour as radiant force, sound as voluminous distinction, and heat as spiral inclination."

Quaint, dogmatic, and semi-unintelligible as Mr. M'Donald's work is, we by no means condemn it, but we sincerely wish he had put his views clearer for the uninitiated, to whom his arguments must be incomprehensible. The following general summary, or rather selection of passages, will give the principal points of his views. We cannot undertake to translate into vernacular English even these, but this selection will enable our readers to judge whether they will be inclined to undertake the study, it cannot be merely the reading, of Mr. M'Donald's lucubrations:—

"Taking the two kinds of existence to which all the components of the universe can be referred, there is evolved space—or, as it is ordinarily termed, vacuity—and solidity, or a something which ever retains the continuous impress of distinct characteristic individuality, endowed with formal repulsiveness.

"As regards space, void and vivic, it seems that it is and must be a creation, because the genetic record tells of the creation of the heaven and the earth in the beginning; and if a creation, it of necessity exerts a more potent influence than the mere individual atomic solid, because its subtension is various and consonant to the mode and manner of its outline, being thus the working principle of the universe, the atom is the thing or material worked upon; accordingly as is the outline of a space varied, so is the internal influence. The outline may be varied, but a space created cannot be annulled. It may be divided, re-united, caused to become monocentral or spherical, bicentral or elliptical, or polycentral, having varieties of outline; but the abnegation of its being, as an abidance and voluminous property, involves a *reductio ad absurdum* termination. A space appears as if you can do anything with it but nullify its existence; an atom, as if you can only combine or separate its units,—an individual existence without variety." ....

"The Genetic record also implies the existence of life before light as in the commencement or in the beginning, before the exertion of such,—thought and capability before the exhibition of geometric realities—the existence of the Creator before the creature. From the first institution of antagonistic influence or force, although the indications of formative abidance would be various, the rule in the long run would be subdominant to requirements depending upon the numerical ratio of the prime forces, whether one, two, three, four, five or six, and to the intermutual balance of these powers, and the static ability of their forces. Although the prime powers evolved would be the distinguishing exterior characteristics of this era, yet the internal exhibition of antagonistic force confliction would develope inferior, medial, and superior organisms according to the ratios, multiplying in intensity of contradiction and confluence.

"The sixth day being also an animal life era, it becomes consonant to the purpose of our theme to speak of them and treat them as one, only with this difference, the fifth era opens unto us all appertaining to curvilinear, circular, and hemispherical purchase becoming ovoid combination and pointed repulsion, or the advancement of life into death. The sixth era, on the other hand, opens and explains the limit of death and the retrocession of death unto life eternal. The wording of the sixth day is:—'And God said, Let the earth bring forth the living creature after his kind, cattle, and creeping thing, and beast of the earth after his kind. And God made the beast of the earth after his kind, and cattle after their kind, and everything that creepeth upon the earth after his kind: and God saw that it was good.'

"The main distinction between the fifth and sixth day is, that water is the vehiculous medium of the fifth; earth of the sixth. The fifth day tells the story of wave or undulant cohesive advancement with a tendency towards rest and parallel plane decadence. The sixth as the beginning of arrest and retrocession, that of continuous regular gradation and comprehension. It encloses all that has been done prior to its institution, balances it, and struggles to lead it back—condense, and confine the volumes of space within an harmonic boundary, and balance such upon an equidistant centre. As the former eras were but the lustrous eviction of a life evading and relapsing into rigidity or death, so this is the toned regular balance of progressional static requirements, leading unto an eternal state of enduring stability, its oneness of volume harmonized throughout its entirety. If the times of the six points had been simultaneously taken and originated, the numerical relations of the internal harmony would have been equal, similar, and equibalanced; therefore an octaedron of regular tension would only have been attained. The Genetic record, however, tells us, and nature bears testimony to the fact, that time elapsed between the institution of each of the six points, therefore we understand how that although all must continually tend towards the true geometric centre of the universe, such point is not the electric status of never ending rigidity, but the focal realization of eternal abidance, a referential gradation of harmonic rest and stability. This likewise discloses the appropriateness of the idea of God resting upon the seventh, because the seventh point being once attained, and such point centrifugally varied, the inevitable conclusion is the exterior exhibition of eight balanced points as cubic comprehension, when the six points of prime institution become as it were extinguished and null or centre of each square, and become again balanced and developed at the points of each square. When the last trumpet is sounded, and the new heaven and the new earth become perceptible, then will eternal perfection have been attained, and the eighth or everlasting era be inducted. Centrifugal and centripetal force will then have been truly harmonized, and solidity, vacuity, and space influence concordantly appropriated. It may be that those who are possessed of, and have cultivated their superior intellects, may be enabled to travel through the universe under the guiding protection of the Deity, if their intellects are attuned consonant to His will; whilst the inferior and non-consonant intellects must have more restricted range. The inferior intellects, happy in their restricted sphere, the non-consonant superior intellects, cropt of indulgences, their state, therefore, what!—will it be that of an unsatisfied, envious yearning, or a pruning and reduction of unsightly excrescences until they sink into some inferior position, low—low in the scale to what they might have occupied.

"Leaving this intensely metaphysical subject, we can perceive how the point of the seventh being once attained, true and eternal sphere motion would be gradually originated, increasing and increasing until the limits of the six prime stations are reached. The eternal sphere or globe would then have attained its utmost limits, and influential force would then expend its remaining impulses in the formation of a cubic outline, exterior to the sphere, with the six prime powers centre of each square. The problem of the New Jerusalem, mentioned in Revelations, has bearing upon this point, because it is there stated that the city lieth four-square, and the length is as large as the breadth; and also that the length and the breadth and the height of it are equal.

"The millennial era, or the binding of Satan, is likewise of peculiar importance here, because the first resurrection is perhaps noiseless and gradual, the second instantaneous and reverberatory; as if it were the sudden resolution of all dissonant materialisms, and their forcible banishment either to centre or circumference, the abode of the truly blessed being medial between the two extremes." . . .

"If we look upon the creation of Adam as a mechanism endowed with faculties resembling those of his Creator, then it seems we must accord to man three powers, those powers being capable of varying in all grades, but never capable the one of totally comprehending the other, of separating itself therefrom, or of maintaining a separate position apart, to the total exclusion of the other two. Ever three, and yet one; ever capable of variable extension or contraction, and yet mono-central as regards the combined unity.

"Adam, being created, could not be totally self-reliant, of necessity he must be dependent upon the care of his Divine Creator. The life-volume of Adam's existence not being self-eternal, or not self-existent, at least one plane or point of such volume must be everly stationary or reliant.

"If one supremely selfish attempt were made to live alone and independent, the Adamic creation having a beginning, seems to give the result thus: A living death or a resolution of the Adamic life or beauty into simple atomic elementary existence, because the power becoming totally mono-central, would return unto the key-note of its first production, become electrically repulsive, and subsiding into silence end the life harmony of man upon earth. The effects of eating of the tree of life, would, according to this view, have been a centration of the life vivifying forces so as to cause eternal intellectual death, or constriction of the life components, giving, therefore, life eternal as a simple exercise of station—a mere atom. On the other hand, the effects of eating of the fruit of the tree of the knowledge of good and evil, implies an inquiring mind, a desire to know without the self-assumption of supreme arrogant presumption, a species of timidity mixed with the sin. As the tree of life gives only one point or radiant instantaneous death, the tree of the knowledge of good and evil gives two points, or an undulant tendency, causing the three to become five, and therefore requiring time till the power vacillating, extending, and fluctuating, gradually subsided into death or various grades of simple outline existence. This human life decadence we know and believe to have been arrested by 'Jesus' perfectly accomplishing an appropriate work at, and during the appointed time." . . .

"Imperfections and mis-statements may be found here and there in the Bible, because as a book it is subject to the variable free will force of man. Be that as it may, if from such a book we can glean sufficient to enable us to know the how and why of creation, and of the appearance and glorious work of Jesus, it is all that is absolutely necessary for the purposes of salvation.

"As a still more condensed view may be agreeable to the purely scientific, the following is given:—

"There are three species of space occupation, and these are the vivic or fluid occupation of space, the void, and the atomic, or the rigid unchangeable delineation of a space.

"There are three varieties of space harmony;—the magnetic, thermic, and electric. The magnetic relates to motions within a fluid or connected volume. The electric relates to the actions of distinct and separated volumes. The thermic to the compound amassment of distinct volumes and interspersed fluidities."

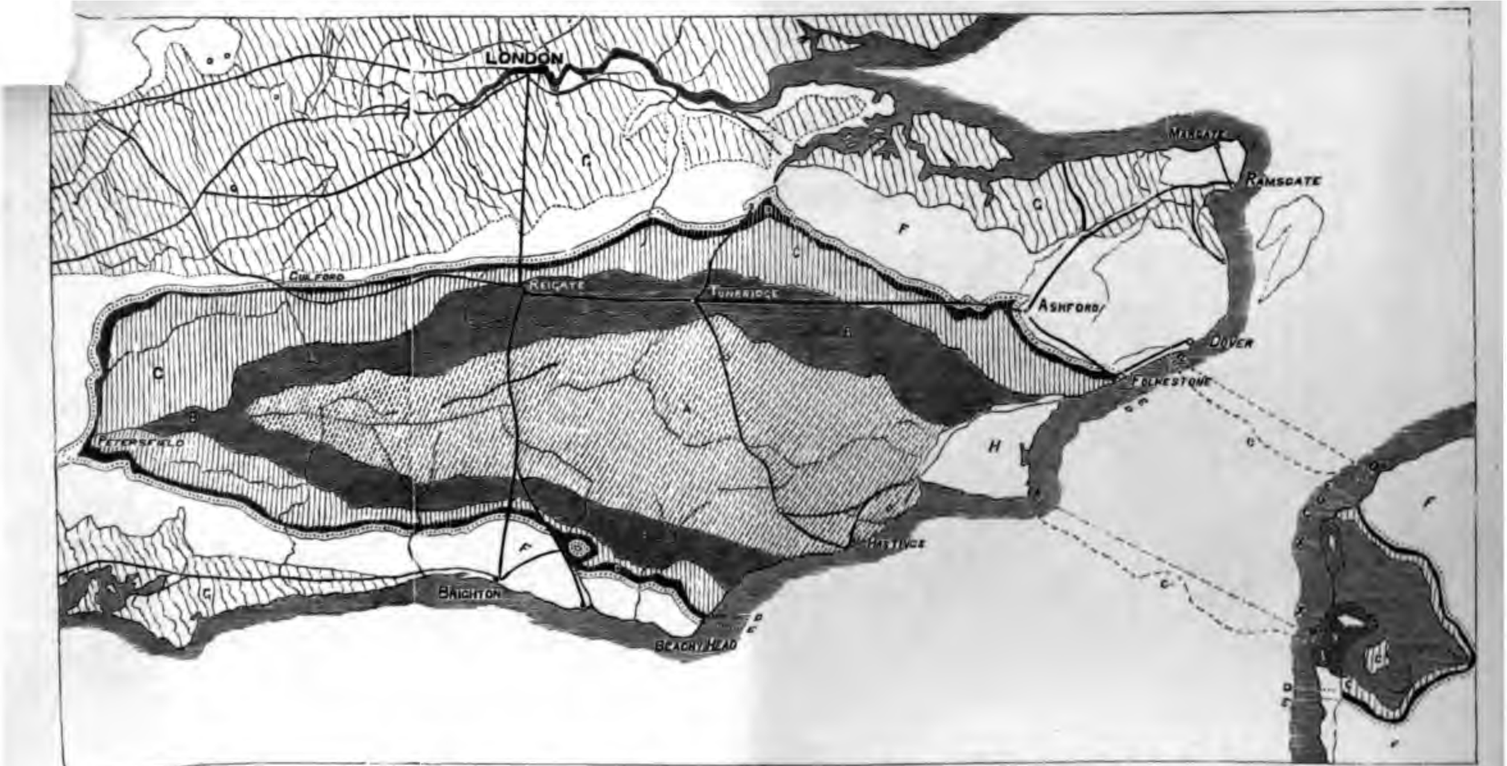
We have given in these selections a fair sample of the work; every individual who reads it must judge of its value for himself.

Introductory Text-book of Physical Geography. By David Page, F.R.S.E., F.G.S. London and Edinburgh: Blackwood and Sons. 1863.

What can we say more of Mr. Page's book than that it is the best of its kind? We have said the same of his geological text-books before; and we repeat the praise for this. Mr. Page's books, however, deserve more positive praise even than this, for in themselves they are excellent treatises, characterized by great painstaking in getting good information, and judgment and ability in using it when got; while his originality of thought always carries his works far beyond the class of compilations. This text-book of physical geography, like the author's 'Introductory Text-book of Geology,' conveys in a simple, sytematic manner, the leading facts of the science to which it relates; and the learner is not troubled with masses of details which it is impossible for him to remember, nor is he debarred from study by an array of subsidiary topics and data altogether unneeded in the first elementary comprehension of a science. The contents are physical geography, as a science; the general condition and planetary relations of the earth; —its individual structure and composition; distribution of land and water; the superficial configuration of the land—its highlands, its lowlands; the water—its rivers and lakes; climatology; the atmosphere; the distribution of plants and animals; ethnology—races and varieties of man: and a general review, with deduction of the whole mass of subjects. We need scarcely add, Mr. Page's book has our good wishes and most hearty recommendations.

The Geology of Leek. By Thomas Wardle, F.G.S.

Leek, in Staffordshire, stands chiefly on the Triassic rocks. The Carboniferous rocks also appear, and Post-Tertiary deposits are met with in the district. The subdivisions of the rocks, their principal localities and ranges, are well and orderly described; as are also the physical aspects of the region, its rivers, brooks, and springs. At the end of the work are model lists of strata, with the characteristic fossils bracketed to each, and a note of the locality in which each occurs. There are also classified lists of fossils, and four very well lithographed plates of figures. The book is very nicely printed, on very good paper, and bound in cloth. In every way it deserves to rank with the best local books in our literature, and is one of a class that we should like to see more frequently produced.



MAP OF WEALDEN AREA OF SURREY, KENT, SUSSEX, AND THE BOULONAIS.

THE GEOLOGIST.

AUGUST 1863.

THOUGHTS ON DOVER CLIFFS.

By the Editor.

ıe shore of the English Channel, half hidden by its shady of trees, stands Walmer Castle, the sweet red roses trailing up mparts and clustering in lovely bouquets round its cannon, em- tic of the peaceful end of him—illustrious Wellington—whose ·eath ceased within those grey stone walls.

m this lonely beach, against whose front the "wild waves ›ss play," creating their own barrier in the great banks of ͽ which ceaselessly they raise, we look out upon the fleet of

Fig. 1. Shakespeare's Cliff, Dover.

s in the Downs, and far beyond the long white line of surf— ıroud of many a noble heart—that marks the Goodwin Sands, ı the distant coast of France.

From Walmer, the "white cliffs of Albion," so conspicuous here for their numerous and regular bands of flints, gradually rise towards Dover, whose far-famed castle stands on a mountain mass of microscopic shells, overlooking the red-roofed tenements of that ancient port, winding along the deep valley which at this point cuts abruptly through the strata.

Fig. 2.—Section of the Cliffs from Walmer past Dover to Lympne.
1. Rubble. 2. Upper White Chalk, with flints. 3. Middle White Chalk. 4. Grey Chalk. 5. Upper Greensand. 6. Gault. 7. Folkestone Greensand. 8. Sandgate Greensand. 9. Kentish Rag. 10. Neocomian Sand. 11. Weald Clay. 12. Alluvial (Romney Marsh).

The opposite hill is furrowed in its entire extent with the trenches of the citadel, and at the foot of its steep cliff is the long and narrow street which formerly, when the town was walled, led to the Snaregate.

On the western side of the harbour the bold front of Shakespeare's Cliff forms the commencement of a splendid range of cliffs, which rise to a height of nearly six hundred feet, the fallen masses of which constitute a picturesque and romantic undercliff, carpeted by a short crisp herbage, and abounding in beautiful plants that furnish subsistence to many of the rarest British insects.

On the shore, a narrow seam of dark greensand represents the "firestone" of Godstone and Reigate; and gradually rising from the flat strand of Eastwear Bay, the blue gault forms the ruinous promontory of Copt Point.

The sandstone cliffs at Folkestone—more rugged and still more picturesque, though less singular in character than the sheer white masses we have just passed by—are covered by white marl and ochreous gravel, containing hundreds of the bones of extinct mammals, mammoths and hippopotami, savage hyænas and gigantic deer and oxen; while above and beside them are buried the rude urns, rusted weapons, and mortal relics of our Saxon ancestors.

As we skirt the brow of this high ground, from amidst the yellow-sands below, layers of rough rock jut out, and dark furze ;gy bushes luxuriate in the softer intermediate soils.

ıding to the lower level of the pretty village of Sandgate, ıus springs and equisetaceous plants mark the spongy pyri-iddle" Greensand; and as we trace along the verdant slopes the to Lympne, the grey hard "Kentish rag" on which :, crops out, and we step over hundreds of sparkling rills of ater with forests of crisp watercress.

solemn in their teachings become the mouldering bones in ;ed crypt of the old handsome church at Hythe, after an in- of the tiny Cypridæ in the Weald Clay on which they rest; ıther-beaten Studfall, with legends older than those of its days written in its massive lichen-stained walls, speaks to touchingly of the vicissitude "of all things human," when :t on the landslips that have overturned its massive towers, d guarded in its ancient days of glory by the invincible of the "Empress of the World,"—the "Eternal City," now ıd prostrate as these crumbling ruins.

inch of the ground is fraught with historical associations l incidents, and every fragment is filled with natural wonders ırry the mind beyond the ages of history into the boundless rminable past, heightening the enjoyment of the picturesque around, and mingling with the very essence of our souls, ad-, love, and gratitude to that great Being whose attribute is , and whose kingdom is illimitable space.

ınlarged and ennobled our ideas of his inestimable supremacy as we trace through the records of the great geologic ages, lual unfolding and slow and solemn workings out and de-nt of his far-foreseeing plans, and find no traces of discord, or chaotic confusion, but see in the earliest times the radi-ıis glory, and in his, to us, most primitive creations the same ıpressions of his power and wisdom as in the most recent t elaborate of his works.

ı is perhaps no isolated portion of geology that has more ›roved the immensity of geologic ages, than the group of ə are considering. As at the present hour the sea is washing ffs and shores, and dispersing the material,—

> "Ever drifting, drifting, drifting,
> On the shifting
> Currents of the restless main;

Till in sheltered coves and reaches
Of sandy beaches
All have found repose again,"—

so in former ages, the finer particles of earth derived from the waste of the land were carried by the currents of the ocean miles and miles away, and, deposited in its tranquil depths, have formed those important argillaceous, calcareous, and sandy strata of which the external crust of our globe is mainly composed.

Such operations and the accumulation of organic débris, chiefly of a microscopic character, effected the deposition, and volcanic or some other equally powerful internal force, the elevation of those great masses of stone, sand, and clay, which are grouped by geologists together as the Cretaceous formation.

The fossil shells, fishes, echini, and sponges of the Chalk and its associated beds, clearly prove their marine origin; while the remains of sharks, nautili, ammonites, and other forms of animal life usually predominant in warm latitudes, are, without going into more minute details, sufficient to indicate the warmer temperature and different climatal conditions of our geographical region during the Cretaceous era.

Of the many records of the past, nothing is useless; no portion without its value. The embedded shells give us important evidence of the rate of the accumulating sediments, and record their progress. In the beds we are studying, especially in regard to the Chalk, they teach us how slow and gradual was the deposit of sediment; for the encrusting parasites on fossil bones and shells, betoken how long these dead objects lay in the ocean-depths ere they were finally entombed in their massive grave.

How slowly and solemnly did the mighty work proceed; how vast the period over which it extended. Each of all the myriads of those departed beings whose remains teach us the history of their age, must have had its term of existence, have lived and died, as do the creatures of the present, ere the growing cemetery enclosed it in its "cold embrace."

"When we see," says Lyell, "thousands of full-grown shells dispersed throughout a long series of strata, we cannot doubt that time was required for the successive multiplication of successive generations;" nor when we see the internal parts of fossil oysters and other shells covered with Bryozoans, Serpulæ, and other encrusting bodies, can we doubt their having lain at the bottom of the sea after death, while these parasites lived, grew, and died before they were embedded in the slowly accumulating mud.

In my former collection, now the property of the town of Folkestone, there is a fossil oyster—by no means an uncommon example—having a second oyster attached to the inside of one valve. This specimen could neither have been suddenly enveloped nor even embedded shortly after death. Decomposition and entire disappearance of the animal must have taken place before the smaller oyster could have fixed its residence. This too must have died, and the connecting ligament of its valves have decayed, before the detached valve was worked away, and both oysters, old and young, embedded together.

Of all the numerous specimens of the prickly sea-urchin tribe from the Cretaceous rocks, to find one with any of the spines attached is rare, while the test itself is often coated with Serpulæ and other parasitic forms. In such cases also, not only death and the subsequent decomposition of the muscular integument must have happened, but the spine-divested body-shells of the Echinoderms must have remained exposed on the sea-bottom, while these extraneous beings lived out the full periods of their existences.

The extremely slow formation of the Chalk is further displayed in its microscopic structure.

Amongst all the wonders which geology has revealed, there is nothing perhaps more wonderful than that the very substance of solid rocks should be composed of the remains of the minutest animalcules. Yet such the microscope has shown; and chalk is one of the numerous instances.

Every atom, each individual particle, was once part of a living creature. Thousands of miles of solid rock, hundreds of feet in thickness, form thus a mighty tumulus of fragile invisible beings,—the cemetery of the unseen; beings not suddenly nor violently destroyed, but that naturally sported away their lives above the dead ones of their race, a million of whose carcases scarcely formed a cubic inch of the Cretaceous ocean's mud.

Beautifully and truly has it been said, that "the majesty of God appeareth not less in small things than in great, and as it exceedeth human sense in the immensity of the Universe, so doth it also in the smallness of the parts thereof." The deposits of the Cretaceous period are very extensive, and are found in Belgium, Holland, Prussia, and over the greatest portion of Europe. A map of the divisional boundaries of the ancient lands and seas of that remote geological age would display very different dispositions of continents, islands, oceans, than now exist. All through the great Tertiary ages, the Pleistocene and the historic periods, the sea has been at its ancient toil, destroying and renovating, pulling down and levelling. All through those vast periods the winds and rain, and frosts and snows have been abrading and disintegrating the mountain-rocks, and slowly bringing down the detritus to the river-valleys and the sea. All through those vast ages—reckonable only by millions of years—the earthquake and the volcano, subterranean expansions and contractions have contested with the air and the water the dominion of the earth, and have maintained the supremacy of the dry land over the storm-crested "waste of waters."

We have been over some twenty miles of ground in our brief and rapid notice of the Cliff-section of the Kentish coast; we have gone ages back in our reflections; we have spoken of the rocks which form those cliffs as having been the mud beneath or the sands upon the shores of an ancient ocean long since passed away. Let us sit down now under the shade of the massive walls of the Roman *castrum* where first we halted in our mental ramble, and shortly tell the history of these lofty cliffs, "white, blue, and grey," yellow and green.

Fine calcareous matter, stiff mud, siliceous sands, all the produce of the salt sea, all once deposited in the depths or on the shores of ocean, now two, three, four, and five hundred feet above the waves. All once piled nearly flatly over each other like so many books on a table, now tilted up edgewise like volumes in an open space on a library shelf. If, reader, you are a geologist, you will know something of what I am going to tell, for the Wealden district of which our section forms a part is too remarkable not to be well known to scientific men. If you are not a geologist, then, though I tell an old tale, it will be one that will mightily interest you if I tell it well.

There was—how many ages since no one can say, no figures express; but it was long, long ago, if even we could reckon by ages—an ancient continent spreading over all this region round, not then so temperate as now, but hotter and more like the tropic band; on its shores tall trees and a rank luxuriant herbage grew. Gradually the forest-covered soil sank down, and gradually the great river that drained the continental tract spread wider and wider its mud and ooze. There in its swamps gigantic lizards and winged reptiles sought r food, and there oft during the æstival droughts millions of :sh-mollusks on the half-dried banks retreating into their spiral nes were baked by the hot sun into beds of beautiful marble (Berdsen and Purbeck), so often since polished into pillars for holy ces, or chiselled into seats for saints.

n the lapse of further ages—for Time's march has never stayed— salt waves curled and broke in writhing foam, and the sea-breezes pled the ebbing tide over the shallow sands, which the rain spated and the creeping things of the shore streaked and dotted with ir footprints.

Down further yet went the ancient land, and the mud took the ce of the sand; further still and the fine calcareous ooze of a per ocean succeeded to the mud; and the river-mussel and the tile were supplanted by the ammonite and the shark; the trees l insects by the mollusk and foraminifer.

The ancient trees of that old continental land are still dug up in Purbeck beds; the bones and teeth of the Iguanodon, the Pterodactyle, and other gigantic reptilia are often exhumed from the sands d clays of the Wealds of Kent, Surrey, and Sussex; and the rip-marked sandstone is daily quarried at Horsham, Hastings, and ye. Ammonite and shark, crab and shell-fish have left their lid cases, bones, and teeth in the ragstone, greensand, and gault, d even traces of the soft flesh of the latter yet remain as brown dules of molluskite in some of the sandy beds of stone.

Further still sank the ancient land with its overpiled sediments til the faint currents of the ocean-deeps scarcely stirred the tiny lves and weightless shells of microscopic entomostracs and foranifers,* powdering the fine calcareous mud in depths which the ht of heaven only dimly reached.

All these various beds, formed during the vast period of those ange changes, however dissimilar in their present state they may the first glance appear, both in mineral composition and in the ysical conditions of their deposit, are nevertheless found to be turally associated, when the sequence of their succession and the ture and value of their organic remains are known.

No general distinguishing mineral characters can be universally igned to these various divisions, for the composition of the beds of

* Some portions only sank to this great depth. The area of Kent and Sussex was rer the old continent, and consequently sank into less profound though still deep er.

every age varies with their geographical extension, and according to the ancient conditions of that part of the Cretaceous sea on which they were deposited. Thus in places far removed from Kent the argillaceous gault of England may be represented by a hard rock or an incoherent sand; or the fossils of the Upper Cretaceous beds may be enclosed in strata totally unlike the soft white chalk of England; the upper beds of which, too, in some parts of Europe are devoid of those bands of black flints which so conspicuously characterize our own: while on the other hand the Lower Chalk which is here without them, elsewhere on the Continent encloses numerous bands of siliceous concretions. The grey chalk also in some places abroad contains white-coated flints and beds of chert, and may be represented by a limestone in one geographical district, and by a sand or a clay in another.

The various divisions of the Cretaceous formation in the limited area this book describes are, however, marked by real discordances, both petrological and palæontological, while some connecting organic forms link the whole into one proper geological group, containing upwards of 5000 characteristic species of fossils distinct from those of the Oolitic strata below, and from those of the Tertiary beds above.

But to return to our history, from which we have thus somewhat digressed. All these strata, which we have so far traced as sea-deposits, have been raised from their nearly level position and tilted with slightly upturned edges. In our section (fig. 1) they dip 7° to the east-north-east. In Sussex the like beds dip the opposite way, and they vary all round the semicircle of the Downs, assuming a more and more northerly dip as they approach from either hand its central portion in Surrey; pointing indeed away in all directions from a common centre near Battel, in Sussex, as may be seen in the map, Pl. XVI.

At intervals these chalk downs are broken by transverse gorges or river-valleys, while the great interior area of the Weald presents the lowermost, or, as from this circumstance they are termed, the Wealden strata at the surface entirely divested of those cretaceous sandstones, clays, and chalks, which in the Kentish cliff-section are seen to repose upon them.

Now either those chalk-strata and greensand were never deposited over this area, which their thickness at their truncated edges, as well as the steepness and height of the surrounding escarpment of the

Downs forbid us to suppose, or they have been swept off from it since.

To this latter conclusion we must inevitably come; but then the question arises whether the Cretaceous and Upper Wealden beds extended over this area in their full thickness; if so, from off this region the rocks must have been swept away to the extent in vertical height of more than 1400 feet.

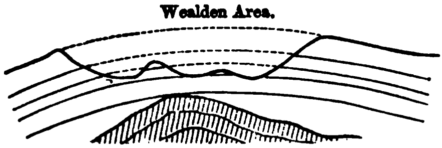


Fig. 3.—Dome-shaped strata over the Weald, of equal thickness throughout.

Some geologists, however, and with good reason, consider that the beds became thinner as they overlapped the Wealden district; and it is certain a great submarine ridge has existed at this spot from the Carboniferous era, if not from an even earlier date. The sea might therefore naturally be supposed to have shoaled over this tract, and consequently the deposit would not have been so thick as in the deeper parts of the sea.

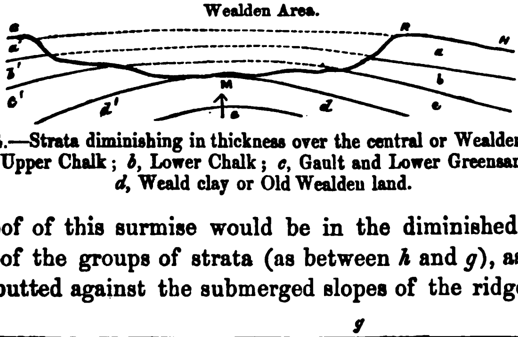


Fig. 4.—Strata diminishing in thickness over the central or Wealden area. *a*, Upper Chalk; *b*, Lower Chalk; *c*, Gault and Lower Greensand; *d*, Weald clay or Old Wealden land.

The proof of this surmise would be in the diminished collective thickness of the groups of strata (as between *h* and *g*), as one after another abutted against the submerged slopes of the ridge and was

Fig. 5.—Ideal section of strata abutting against a ridge. *a*, Upper Chalk; *b*, Lower Chalk; *c*, Gault and Lower Greensand; *d*, Neocomian beds; *c*, Old Wealden land.

terminated; or in the difference of diminished dip of the superior over the inferior strata.

Fig. 6.—Ideal section of strata thinning out against a ridge.
***a*, Upper Chalk; *b*, Lower Chalk; *c*, Upper Greensand; *d*, Gault; *e*, Lower Greensand; *f*, Neocomian beds; *g*, Old Wealden land.**

We have already pointed out the convergence of the lines of dip towards a point near Battel. There was the apex of the great dome, the outer concentric coatings of which, whatever their original thickness, have since been sliced off—denuded by cutting action of the waves as the island-dome was slowly elevated out of the waters.

Now the physical features of this region, as we at present see them after its upheaval, show that the area uplifted was the area of weakest resistance to the upheaving or expansive forces below, and that that area had a configuration not unlike that it still retains, although it would appear that the denudation of the upper beds was carried on synchronously with the gradual upheaval of the mass throughout, *at least* throughout the early Tertiary period, and since the fracture of the river-valleys, *at least* over the area enclosed by the downs, from which the débris of the shattered beds has been cleanly removed. (See Fig. 12.)

As certain as the laws of mathematics are the laws of such elevations. The hills, irregular as they appear to be, are not vagaries of nature, nor are the valleys fortuitous cavities. The Wealden area is an irregular curved oval, cut through by the fissure of the English Channel; the counterpart encompassing the neighbourhood of Calais and Boulogne.

If one applied a pressure from beneath to a deal table, a tile, or any other square or straight-sided object, it would split linearly across

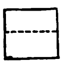


Fig. 7.

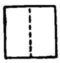


Fig. 8.

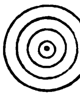


Fig. 9.

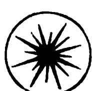


Fig. 10.

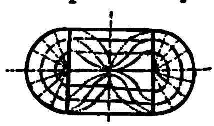


Fig. 11.

in one direction or the other, as in Fig. 7 or Fig. 8. If one applied the pressure against the under surface of a drum-head, the parchment would split either in concentric lines, as in Fig. 9, around, or in radiating lines, Fig. 10, from the centre. Now, an oval is practically a compound of the square or parallelogram and the circle, as shown in Fig. 11; and the consequence of the upheaval of a dis-

:t possessing a contorted oval shape by an equally-pressing power n below, such as an expanding volume of gas or steam, or the ex- ısion of a heated rock-mass, would be to fracture the superincum- ıt rigid beds in lines partly concentric, partly straight, partly ra- :ing and partly curved, according to their position with respect the centre or sides of the region upraised.

Such are really the characters of the lines of the hills and valleys :he Weald and the Chalk gorges. The comparatively straight line the St. Leonard's and Ashdown hills passes by Horsham, Crow- ough, and Wadhurst; the concentric ridges by Lewes and Dork- , while the diverging radiating lines are the great cross-fractures ough which the rivers of Kent, Surrey, and Sussex find their outlets the sea. (See Map, Pl. XVI.)

To return again to our history. Since the sediments of the Creta- ous ocean were consolidated into rock, they have been furrowed by other ocean as they rose into land, and other newer deposits formed their débris. Of such origin are the Thanet sands and the plastic ıys of Reading and the Isle of Wight. These and many other of Tertiary beds of the surrounding country are nearly wholly med of the greensand, clay, chalk, and flints of the wasted Wealden ıd, and have been accumulated on its ancient successive shores.

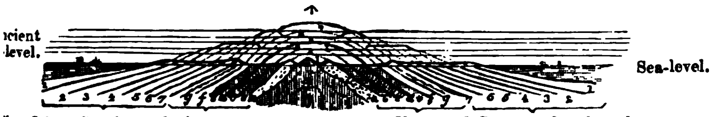


Fig. 12.—Section of the present strata across Kent and Sussex, showing the successive ancient sea-levels at which the former Wealden dome was periodically cut away as it rose above the sea: the Upper Chalk, 1, being first cut away; then the Middle Chalk, 2; then the Grey Chalk, 3; then the Upper Greensand, 4; then the Gault, 5; and finally, the Lower Greensand, 6, and Neocomian, 7. These beds forming consecutively the corresponding Tertiary beds, No. 1 to 7; on the older secondary strata, *a* to *g*. These are *a*, *b*, Neocomian and Lower Greensand; *c*, Gault; *d*, Upper Greensand; *e*, Grey Chalk; *f*, Middle Chalk; *g*, Upper Chalk.

The Tertiary period passed away, and the age of the great mammoths cceeded. On our hills and plains, and in the alluvia of our river- eys, are spread the bones of elephants, deer, hippopotami, and oxen t ranged across the narrow isthmus which then connected our land h France, and which still leaves traces of its former position in ribbon of shallow water between Folkestone and Boulogne.

nteresting indeed are the inquiries—When was the Wealden dome t raised and how denuded? When were the British Isles disjointed from the continent of Europe? When were the white cliffs of England split apart from those of France?

A submerged or island dome, as we have already said, appears from all we know to have existed over the site of the present Weald at the close of the Coal Period; and from the indications we derive from deep borings in the surrounding regions, it would be inferred that the Triassic beds were certainly wanting, and that the Oolitic or Jurassic formation was also absent, the Wealden beds reposing, in all likelihood, directly on the coal-measures.

That this region in the early Cretaceous age was in close proximity to dry land is certain, from the fossil trees and the reptilian bones found in the Lower Greensand quarries at Maidstone, and inversely from the thinness of that division in the Boulonnais.

From these and many other circumstances, it would appear that England was not cut off from the great mass of land then stretching away to the westward by Cornwall and Devonshire on the one hand, and Brittany on the other, at the close of the Cretaceous era; while the evidence of the Pleistocene deposits proves that the fissuring open of the whole extent of the English Channel was either just prior to, or coincident with, those early tribes of the human race whose remains and rude stone weapons are found associated with the half-petrified bones of the gigantic beasts of that remarkable age.

But whenever this may be supposed to have happened, the same convulsions shook both countries alike, and the process which lifted up the Wealds of Kent and Sussex raised also the hills of Boulogne and Calais, and left them all portions of the same vast mound, until that other and later catastrophe fissured out the "narrow stream," on either side of which dwell those great and glorious nations of whom the poet wrote that they abhorred each other, but for whom science now has changed the deadly war of mortal strife into an honourable rivalry for supremacy in the arts of peace.

Strange thus that science should bring down the fracture of the Channel to the age of man! Have the old traditions of the Armoricans aught of relation to this great event,—the rupture of the British Channel? Have the tales of the loss of "forty miles of land and sea," so current in Brittany and Wales, been handed down from an antiquity far more remote than that to which they are usually assigned? Is there any probability of that submergence of the Léonnais that Norman troubadours sang of when they told the sad story of Guinevra's falseness to her noble lord, being concurrent with the isolation of the British Isles? We do not, of course, take for true story the highly-coloured scenes of a romaunt, nor believe in all the wonderful doings of King Arthur, Sir Tristram, Meliades, and the other heroes of the song-stories of the twelfth and thirteenth centuries; but we do know that many of these fable-songs were based on still more ancient legends, and may not these lays be but the embodiments in after ages of primitive traditions of far, far remote events?

Through Kent there is a narrow ancient way, now known as the Pilgrims' Road, for along it our first of poets, Chaucer, made his "merrie motley cavalcade" to wend its way to Canterbury. People, in less searching times than these, believed the road went on to Cornwall, and that along it Phœnician merchants brought their precious tin. Whether one end of this primitive way ever went towards Cornwall, or whether remnants of that one end may still be found at our British kingdom's end, this deponent saith not; but he does believe, —it may be but a childish fancy, for we like to deck our childhood's cherished grounds with strange romantic fancies,—that its other end does end upon the Folkestone heights, and that only now because it can go no further, but whence it might have crossed the "narrow sea" before the chalk cliffs there ended it so abruptly. Strange it is to think that primitive men and mammoths might have walked along that road. The grass springs up and withers away, and the silent earth telleth no man's history.

FORAMINIFERA OF THE CHALK.

By the Editor.

The Foraminifera figured in Plate XV. are some of them copied from D'Orbigny's 'Memoir on the Foraminifera of the Chalk near Paris,' and some are from drawings of Cretaceous specimens lent by a friend. The figures do not furnish anything like a perfect or consecutive series of these interesting Microzoa, though some of the most common forms are here depicted, and will well serve the purpose of drawing the attention of our correspondents and readers to the points of interest referred to at p. 234, No. 66.

Professor Rupert Jones, F.G.S., has obliged me with the following notes on the figured specimens:—

Plate XV., Fig. 1, 2. Cristellaria rotulata, *Lamarck*.

A common form of *Cristellaria Calcar*, Linn., sp., having but little keel, and very variable in this feature, as well as in the curvature and elevation of the septal lines, the convexity of the umbones, and the shape of the aperture, which may be either round or triangular. It is exceedingly abundant both in the fossil and the recent state, the largest specimens are found in strata of late Tertiary age and in the existing seas; and under its various modifications it has received many different "specific" names. *C. rotu-*

lata is very abundant in the Gault, Upper Greensand, Chalk-marl, and Chalk. Its occurrence in the red chalk of Yorkshire is noticed in the 'Geologist,' 1859, p. 275; and 1860, p. 420.

Fig. 3. TEXTULARIA TROCHUS, *D'Orbigny*.

One of the most symmetrical of the Textulariæ,* and found chiefly in the Chalk, accompanied with *T. turris* and many other varieties.

Fig. 4, 5. TEXTULARIA AGGLUTINANS, *D'Orbigny*, var.

The Textulariæ are so variable in their growth, forming vesicular or flattened chambers, and arranging them sometimes so regularly and at other times with such a want of neatness, that there may be almost as many names for them as there are individuals. Fig. 4 and 5 are examples of this. Badly grown specimens of the typical form known as *T. agglutinans*, they form links with the variety named *T. fœda* and many others. These Textulariæ are extremely common in the Gault, Chalk-marl, and Chalk.

Fig. 6. TEXTULARIA BAUDOUINEANA, *D'Orbigny*.

This is another common form of Textularia, more symmetrical in outline and in the setting on of its compressed chambers, than Fig. 4 and 5. It can be scarcely, if at all, distinguished from a well-grown *T. sagittula*, Defrance.

Fig. 7, 8. PLANORBULINA AMMONOIDES, *Reuss*, sp.

Most of the Planorbulinæ, especially the larger forms, live in the shallower sea-zones, chiefly among seaweeds; but in deep water they pass into smaller and more compact varieties, such as Fig. 7 and 8. These subnautiloid forms are common in some of the Jurassic clays and in the Gault, Chalk-marl, and Chalk, and abound in the existing seas at depths greater than 100 fathoms.

Fig. 9–11. PULVINULINA† UMBILICATA, *D'Orbigny*, sp.

This belongs to a large family of Rotaline Foraminifera, which group themselves around *Pulvinulina repanda*, Fichtel and Moll., sp. It belongs more especially to the subgroup of which *P. Menardii* is the type. This attains its best growth at about 100 fathoms in the existing seas, but lives well at abyssal depths, even at more than two miles depth; whilst, on the contrary, in shallow water it degenerates into bizarre varieties. D'Orbigny's *Rotalia Micheliana* and *R. crassa*, figured on the same plate (Mém. Soc. Géol. France, iv. pl. 3) from which Fig. 9–11 have been copied, are also varieties of *Pulvinulina Menardii*. These are all three found in existing seas under the conditions mentioned above, and are abundant in the Gault, Chalk-marl, and Chalk.

Fig. 12. LITUOLA NAUTILOIDEA, *Lamarck*.

This is the elongate form of Lituola, the short condition of which is more or less nautiloid in shape. Lituola has very variable states of growth according to its place of living, and is often attached to shells, seaweeds, etc.; it has therefore many varieties, recent and fossil.

Fig. 13. MARGINULINA TRILOBATA, *D'Orbigny*.

Marginulinæ are Cristellariæ with short chambers, arranged without coiling, except at the commencement. They are present wherever Cristellariæ abound.

Fig. 14, 15. LINGULINA CARINATA, *D'Orbigny*.

This is a smooth compressed Nodosaria, the gradation from cylindrical to flattened forms being extremely gentle in numerous intermediate forms; and further, these flattened Nodosariæ, by the backward growth of the sides of the chambers and further compression, gradually pass into Frondicularia; see Quart. Journ. Geol. Soc. xvi. p. 453, pl. 19. Lingulinæ are not very common in the Cretaceous formations. The specimen figured (Pl. XV., Fig. 14, 15) is a remarkably fine individual (magnified six times) from the Chalk of Gravesend. Fig. 14 shows the slit-like aperture.

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* See "Memoir on Textulariæ," by Messrs. Parker and Jones, Annals of Nat. Hist. February 1863.

† For the description of the genera Pulvinulina and Planorbulina, see Carpenter's 'Introduction to the Study of Foraminifera' (Ray Society), 1862, p. 200, 210, etc.

Fig. 16, 17. Frondicularia Archiaciana, *D'Orbigny.*

A narrow form of *F. complanata*, Defrance, of which there is an endless series of modifications. These are really chevron-chambered Nodosariæ. Frondiculariæ are common in the Gault, Chalk-marl, and Chalk, and occasionally are found abundant in the Tertiary beds, and are not wanting in some parts of the existing seas. Fig. 17 is an edge-view.

Fig. 18, 19. Vaginulina costulata, *Reuss.*

A variable Nodosarian form, abundant in the Gault and Chalk-marl; rare or wanting in the Chalk. Fig. 18 is a view of the edge, which is as variable in thickness as the shell is in its other measurements.

Fig. 20, 21, 22. Frondicularia Cordai, *Reuss.*

Frondiculariæ, or flattened, chevron-celled Nodosariæ, vary continually as to the length of the backward elongations of the cells, as the two figured specimens (from the Chalk-marl or the Gault) here show. When they commence with a spiral arrangement of the cells, they are known as Flabellinæ; and excepting in this point, there is little or no distinction between Fig. 20 and D'Orbigny's *Flabellina rugosa;* indeed Fig. 22 shows a little eccentricity of the first chamber. Frondicularia is to Flabellina as Nodosaria is to Marginulina and Vagulina. Fig. 21 is an edge-view.

Fig. 23, 24. Dentalina gracilis, *D'Orbigny.*

A variety of the world-wide *D. communis*, D'Orbigny, which occurs in all geological formations from the Palæozoic upwards. *D. communis* itself is a feeble form of *Nodosaria Raphanus.* Fig. 23 is the end-view, showing the aperture.

In the above remarks I have incorporated much information derived from my friend Mr. W. K. Parker.

CORRESPONDENCE.

Causes of Cosmical Changes of Temperature on our Planet.

That the vine, the walnut, the plane-tree, etc. etc., once flourished within the Arctic Circle, and that Mount Lebanon was for a long period covered with ice and snow, are facts inexplicable by any meteorological causes now in action, every geologist of the present day I believe admits. The question is to what causes, not now meteorologically evident, are we to attribute the great changes of temperature on our planet, which have extended over such long periods as those recorded by the unquestionable and well-established testimony of glaciation. Must we carry our solar system into remote regions of space in order that we may theorize on cosmic changes of temperature, or can we explain these truly wonderful facts by some changes in our own planetary motions, such as our earth getting into a zone of asteroids, to changes in the sun's atmosphere, either as to surface or intensity, as already published by Mr. Mackie, in a former number of the 'Geologist'? With regard to the theory of the earth passing through hot and cold regions of space, Mr. Mackie asks, "If heat be confined to matter, how can we speak of hot and cold regions of space, where by that very admission neither heat nor cold can be?" The reply to this question is not difficult. Matter cannot exist without space, but space can exist without matter. By hot and cold regions of space, I could only mean those portions of space occupied by matter, for where there is no matter there could be no temperature, neither hot nor cold as sensations, nor caloric as a material condition; for whether heat be a fluid or a wave, it can have no existence in pure space, pure space being a negation of everything that is material. The thermal portion of space must therefore be material that is occupied by matter. There can be no absolute void or pure space between us and any visible star, no matter how remote; even though its distance be so immense that the courier ray that now announces to our senses its existence, may have started on its errand thousands of millions of years ago, travelling all that time at the rate of a hundred and seventy thousand miles a second, still in the immense, the inconceivable space so run over by the luminous messenger, no absolute void could have existed, otherwise the star must be invisible to us.

Mr. Mackie is therefore right in stating "that if heat be confined to matter, how can we speak of hot and cold regions of space?" but he should have added pure or empty space where no matter exists, as I only meant those portions of space occupied by matter surrounded by and floating in a thermal ocean; for whether heat be a fluid or a wave, we cannot expect to find the causes of telluric changes of temperature by travelling into regions of space where nothing exists, where there is no entity but nought, "where death is life." Mr. Mackie says (last number of 'Geologist'), "if the sun moves on with his surrounding worlds, these will all travel onwards together in the same ethereal material envelope; and therefore, unless the supposed hot and cold regions of space have temperatures of much higher or much lower degrees than the general temperature of the solar region, the effect would be imperceptible." It is evident that the portions of space so traversed by our solar system at the rate of 57¼ miles a second, moving towards the constellation Hercules, must be material, for so far as we can see any object in the universe, between us and that object there can be no absolute void or pure space, otherwise it must be invisible. Now it is clear that the regions of space occupied by matter cannot be of the same temperature, as the causes that generate light and heat are neither uniform in intensity nor distance. The path traversed by our solar system in space therefore cannot be isothermal.

It is not likely that our solar system is travelling through space surrounded by the same ethereal envelope, as Mr. Mackie seems to think, for this would be, supposing that outside this ethereal envelope nothing existed but pure space, an assumption quite opposed to the facts and reasons already stated. Besides, whether heat be a fluid or a wave, in either case it must be subject to the ordinary influences of physical agencies; therefore the same condition of matter constituting uniformity of temperature could not follow and surround our solar system in its travels through space.

David Leslie, M.D.

Tunbridge, July 19th, 1863.

The Portland Fissures.

Sir,—I hope you will allow me to correct a mistake which you have made in your remarks on my last letter, in saying that my theory was that of "the deposition of the extinct animals in caves before the caves existed." On the contrary, I said that I was of opinion that all bone-caves were only formed by the animal remains embedded in the limestone deposit before its consolidation, and, consequently, before the existence of any caves in it.

The question with respect to the Portland and Oreston fossils is entirely dependent on the truth of certain facts. First, with respect to the Portland fossils, can the statement of Captain Manning, of the 'Willis's

Current Notes,' and of the article in the 'Times,' relating to the new fortifications in Portland, be disproved, that human and animal bones have been found mingled together in fissures of the rock which do not extend to the surface of the rock? If this statement is correct, as I believe it to be, it necessarily follows that the human and animal bones must have been embedded in the calcareous deposit when it was soft, and consequently before the existence of fissures in it; and the men and animals to whom the bones belonged must have previously inhabited some other dry land which probably no longer exists. Again, if the assertions of Dr. Buckland, in the 'Reliquiæ Diluvianæ,' and of Mr. Joseph, mineralogist, of Plymouth, in his letter to me, are correct, that the caves at Oreston, which were only discovered by working away the body of a rock in a quarry, had no apertures, it necessarily follows that the animal remains must have been embedded in the calcareous deposit before its consolidation, and consequently before there were any caves in it, and therefore the animals must have previously inhabited some other dry land. I think it is certain, from the statement of Dr. Buckland, that all bone-caves which have been discovered with apertures through which the remains of large animals could have passed are situated in the face of cliffs, produced, as he says, by diluvial denudation, and that all other caves have only been "laid open by the accidental operations of a quarry or mine." He says, "the existence of caverns is an accidental occurrence in the interior of the rock, of which the exterior surface affords no indication when the mouth is filled with rubbish and overgrown with grass, as it usually is in all places, excepting cliffs and the face of stone-quarries;" that is, in fact, where no mouths have existed but what have been made by the formation of a quarry. For instance, as stated by Dr. Buckland, the bone-caverns in Yorkshire, Devon, Somerset, Derby, and Glamorganshire "were all laid open, with the exception of the caves at Paviland, by the accidental operations of a quarry or mine." The caves at Paviland are in the front of a lofty cliff, produced, according to Dr. Buckland, by diluvial denudation, and there is no evidence that they ever had any other mouths than those which were made by the formation of the cliff.

Your obedient servant,

THOS. D. ALLEN.

Rectory, North Cerney, Cirencester, July 9th, 1863.

[It is perfectly futile to argue upon such bases as Mr. Allen persists in bringing forward. Men who, like myself, have useful duties to perform in life, cannot waste their time in arguing on imaginary bases. Mr. Allen's fundamental base of argument, if not absolutely false, as I and every rational man in the present state of science must believe it to be, is unfounded and unproven. There is *no proof whatever* that the fissures do not extend to the surface: indeed the very good observations of Mr. Fisher distinctly show that they *do extend* to the very surface. Nobody denies that human bones and mammalian bones have been found in the fissures. So have halfpence with human and other bones in caves; but such an association would only lead to an erroneous inference if the circumstances of the association were not examined and explained. If this were not done, we might infer that the mammoth was a contemporary of George II. We really will not print any more "ifs." We distinctly challenge Mr. Allen to prove that the fissures at Portland do not extend to the surface, and, until this is done, we will print nothing more from him on the subject. The theory of the formation of caves by the generation of the gases of decomposition of animals embedded in soft mud is too absurd to attack, —for the volume of gas so generated, if powerful enough to have forced open any large body of earth in forming a cavern would have formed a spherical cavity or gigantic bubble. No such gigantic bubbles of air could ever have formed long, narrow, irregular, flat fissures such as those of Portland. In some of the German caves it has been calculated, from the bones extracted, that they belonged to three times as many individuals as, with their flesh on, the cave could contain. And this and many other arguments have be[en] used expressly by Dr. Buckland to prove the caves were inhabited by the fossil animal[s] while they were living. Mr. Allen can never reconcile these facts with his bubbl[e] theory. As to caves having no mouths, it is certain they must have, or have had, if w[e] find anything in their stomachs. It would be equally consistent to argue that the fl[ies] found in the crop of a swallow must have produced the stomach in which they we[re] found as to argue that caverns could be filled by bones of beasts without any orifice fo[r] the beasts or the bones to get in by.—Ed. Geol.]

The Portland Fissures.

Sir,—Though I should be sorry to do anything which would prolong the discussion on the Portland ossiferous fissures, I am induced to notice a statement, by Mr. Allen, in your July number, p. 253; namely, that a Plymouth correspondent informed him "that there was no aperture in the cavern" (discovered at Oreston in 1859), "and that some of the bones were embedded in 'compact rock.'"

In some sense each of these assertions is correct:—

1st. The cavern when discovered certainly had no aperture; it was easy however to discover where there had been one. The so-called *cavern* was more correctly a *fissure*, originally open at the top; but which, after the receipt of its varied contents, had been closed up with coarse breccia consisting of large angular masses of limestone, which, from time to time, had fallen in from above and become cemented with carbonate of lime.

2ndly. Some of the bones were embedded in stalagmite, which might truly enough be termed "compact rock," but could not possibly be confounded with the true limestone. The quarrymen invariably gave it the distinct local designation of "callis."

It is undesirable further to occupy your space, and indeed, it is unnecessary to do so, as this subject has already been discussed in your Journal. See 'Geologist' for 1859, p. 439, etc.

I am, truly yours,

Lamorna, Torquay, July 17*th*, 1863. W. Pengelly.

The Bone Spear-head from the Essex Coprolite Pits, figured in the 'Geologist' for 1861, *page* 558.

Sir,—As the remains of man or his works, in any geological formation, is one of the most interesting discoveries of the present age, no manufactured article of decidedly geological age, be it ever so rude, should be cast aside or consigned to the cabinet without there being first brought forward all the evidence possible as to its age and its origin.

Therefore when a specimen is procured, we should first show it to be one actually worked, and not formed by chance; secondly, prove from what stratigraphical formation it has been taken; and, thirdly, ascertain how far back in the scale of geological time this formation dates.

The specimen which induces me to make the first inquiry is a bon[e] spear-head, which, about five years ago, I procured from a heap of copro[-] lites belonging to Messrs. Rhodes, Smith, and Co., manure manufacturers of Selby, along with sharks' teeth, *Fucus contrarius*, oysters, and variou[s] pieces of bone, all of which seem to be of the same geological age. Thi[s] 'coprolites had been got from the Essex Crag, but as to what depth exact locality in the deposit this specimen had been embedded I ›en unable to ascertain. It was the reading over, about three years ›f the interesting accounts in the 'Geologist' of the discoveries of ıcher de Perthes, which first caused me to look closely over the ›ns I possessed from the Essex beds, and I was at once struck with n of this bone-weapon, as one being fashioned by hand and not by ıt. It seems to have been struck from the shank bone of some large , and in form somewhat resembles the large flint-pointed implements .bbeville, and is nearly of the same size. Its length is 4¼ inches, ›adth 2⅜ inches.

›ving this specimen to be a true worked one, I will endeavour to that it is a true fossil, and of the same age with the coprolites with it was found. Its colour and density are the same as those of the shells, and other bones; it gives, also, the same metallic ring or clink struck. Its point and edges are a little rounded down and polished ı action of water, as are the various other phosphatic specimens from the same formation. It is marked with slight scratches or particularly on one of its sides.

the third point, I am not sufficiently acquainted with the Essex co--beds to make out their exact stratigraphical age; yet, by the little learnt, I am led to think that this specimen, if a truly worked one f the age of that deposit, is the oldest example known, and may ›ly carry the age of man nearly as far anterior to the specimens in the gravels of Abbeville as those specimens date from the present

ı is an interesting inquiry and worthy of further research; and I hat the noticing of this specimen will be the means of further ex-ı being procured *in situ* from the same formations.

Yours,
J. R. MORTIMER.

ıer, Yorkshire, July 15th, 1863.

FOREIGN INTELLIGENCE.

able article on the former connection between Northern Africa and ern Europe was communicated, by Professor Edward Suess, to the ıg of the Imperial Geological Institution of Vienna, on the 20th nuary last. We have deemed it sufficiently important to trans-

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letter addressed lately by M. Anca, of Palermo, to M. Senoner, s me the opportunity of returning again to a subject which I have ly treated on, some time ago,* and the reconsideration of which seems very proper, not only to show the value of the studies of M. Anca, ıe importance also of such researches in respect to the observations . are now being undertaken at Vienna.

entioned in my former article that the researches of my distinguished ısional colleague, M. Hörnes, on the fossil mollusca of the Vienna , showed the unexpected concordance of many species of our marine with those which are now living on the coast of Senegambia; and

* Meeting of the Imp. Acad. of Sc., January, 1860, p. 159.

I quoted then as a few instances the *Cypræa sanguinolenta, Buccinum lyratum, Oliva flammulata;* and I inferred, according to my notions of the Great Sahara, that there was at one time a sea extending from the Gulf of Gabes southwards as far as the heights of Idijl, in the province of Aderer; thus uniting the Senegambian shores with those of the Mediterranean. I was able even then to refer also to the detailed statements of M. Laurent,* who had been commissioned with the construction of artesian wells on the northern border of the desert, and who, in his report, unhesitatingly represents the desert as having been once widely inundated as a sea-gulf, which broke in through the Gulf of Gabes, and the unmistakable traces of which are still to be seen by the numerous terraces along the southern border of the Aoures Mountain, where the ancient seashores can even now be recognized by the presence of one of the most common inhabitants of the Mediterranean, the *Cardium edule,* the shells of which are there scattered abundantly, and which mollusk seems even yet to be found still living in some solitary pools in the desert. I added further, that even at present large extents of the desert are situated far below the level of the sea, and that from the oldest times the extensive salt-crusts and salt-marshes have been considered evidences of a former overflowing of the sea.

With the progress of M. Hörnes' labours, the impression of the correctness of these statements has increased. We have been not only made acquainted with many species amongst the bivalves, which now extend their propagatory circuit as far as Senegal,—such as the *Lutraria oblonga, Tellina crassa, T. lacunosa, Venus ovata,* and three out of four of our Dosiniæ, namely the *Dosinia exoleta, D. lineta,* and *D. Adansoni,*—but we find also in our basin special and very marked Adansonian types, which at the present time are only to be found living on the Senegambian coast, as, for example, the *Tugon anatina* and Adanson's vagal, the *Tellina strigosa.* The great *Mactra Bucklandi,* also, which does not live on the European coast at all, seems to appear on the Senegal.

All accounts of the desert agree in the supposition of a former overflow; and not only Laurent, but also many other naturalists, independently of palæontological data, were led to this conclusion solely by the configuration of the district and the constitution of the soil. Barth, on his journey from Tripoli to Murzuk, in following the old Roman road, seems to have moved almost always eastwards of and outside the range of the ancient sea; it might not, therefore, at a future time, be without interest to investigate how far the outlines of this old sea correspond with the statements of Duveyrier on the limits of the country.†

The present land-fauna of Morocco and Algiers, as far as Cyrenaica, corresponds entirely in its essential features with the South-European, namely, on the one side with that of the Pyrenean peninsula, and on the other with that of Southern Italy; whilst in Senegal, Gambia, and the other countries beyond the desert to the Nile, the first really African types appear. The elephant, rhinoceros, hippopotamus, giraffe, crocodile, and many other principal forms, do not overstep the Sahara; and the contrast between the Morocco-African land-fauna, and the proper African fauna is, in most classes of animals, very striking, whilst the connecting links with Europe are unmistakable. The voyage of M. Mor. Wagner in the regency of Algiers‡ contains numerous proofs of this, and these are multiplied at every fresh comparison. The crossing of the *Inuus ecau-*

* Bull. Soc. Géol. 1857, t. xiv. p. 615.

† Petermann, Mitth. 1861, t. xiii.

‡ 3 vols. Leipsic, 1841.

us over to Gibraltar is known. The *Sorex Etruscus*, otherwise an ex- sively Italian animal, is to be found in Algiers; the fox, which is hter in Italy than in Germany, appears in Algiers as a still lighter va- ty; and it may be also worth mentioning, with respect to the reptiles, ich are less exposed to the influence of man, that the new 'Erpetology Algiers,' by Strauch, contains well-known South-European species, such *Cistudo Europæa*, *Lacerta viridis*, *Tropidonotus natrix*, *Rana esculenta*, .; and that animals like the *Chamæleon Africanus* appear also in Spain l Sicily. With regard to the beetles, Erichson, having examined the lections of Mor. Wagner, says:—"A number of species belong also the middle-European fauna; a larger number extend over all the st-lands of the Mediterranean Sea, a few inclusive, but the most of them lusive of Egypt, which, in its fauna, exhibits more of the middle- rican characteristics. Most of the species possessed by Algiers are ntical with those of the opposite Italian islands, Sardinia and Sicily, t less so with the mainland of Italy; and the same is the case with the anish peninsula and the opposite territory of Morocco; whilst it is very en the case that the Spanish-Morocco and the Italo-Algerian species ow (?) comparatively an analogy between themselves."* The like pheno- ma are repeated in the land-snails. According to Forbes, the concor- nce of the Morocco snails with those of Spain is so great, that even on e heights the Spanish mountain-snails appear. The *Glandina Algira* is be found, in the smaller form, from the valley of Tsonzo to Constan- ople; whilst the larger variety connects Lower Italy, Sicily, and Algiers.† ther South-European species which seem to have originated from the st,—as, for instance, the *Cyclostoma elegans*,—are, on the contrary, nting in Algeria; whilst the *Cyclostoma sulcatum* appears in the Italian ands, at Malta, in Southern France, South-eastern Spain, and also in orthern Africa. It seems also that all the South-European river mussels e to be found in Algiers.‡

With regard to the vegetable kingdom, and in order not to multiply ccessively examples, it may suffice to record here the *Chamæros humilis*, d its scattering over the coasts of the Mediterranean Sea.

After all that it is not surprising that Andr. Wagner, supported by other series of arguments, so far back as the year 1846 wrote:—"The [editerranean Sea, in a natural-history point of view, separates the north- n border of Africa in a far inferior degree from Europe, than it is on e other hand separated by the Sahara from the principal stock of the frican continent. According to all accounts the Sahara was once over- owed by the sea, owing to which Barbary became one of the Mediterranean lands."§

The present land-fauna teaches us to consider the Canary Islands, Mo- cco, Algiers, and South-western Europe, as a formerly connected conti- ent, which, according to Forbes, probably extended as far as Cornwall. Ve call his fauna the Lusitanian fauna. We shall now proceed with M. nca's communications.

In the year 1860, M. Anca made known|| his discovery in some bone- averns in Sicily, of a quantity of determinable animal remains, which ere accompanied by land- and sea-shells of species still living in that ountry,—as the *Helix aspersa* and the *Cardium edule*. The richest list,

* Arch. f. Naturgesch. vii. Jahrg. 2 Bd. p. 153.

† Marteur, Würtemb. Jahresh. xi. p. 244.

‡ Ibidem, pp. 249, 257.

§ Transactions of the Royal Acad. of Sc. Bavaria, ii. cl. iv. vol. ii. sect. p. 11.

|| Bull. Soc. Géol. p. 680.

that of the grotto of San Teodoro, contains, according to Lartet, the relics of the spotted hyæna, bear (*Ursus arctos ?*), wolf, fox, porcupine, rabbit, *Elephas antiquus ?*, *E. Africanus ?*, hippopotamus (one or two species), *Sus* (probably *Sus scrofa*, similar to the North African), ass ?, oxen (two forms), deer (one or two species), sheep (or a similar animal), a large toad, and a bird. A recent letter of M. Anca confirms the appearance of *Elephas Africanus* in this grotto; whilst *E. antiquus* belongs to another stratum.

Thus we have close to species of European types,—as, for instance, the deer and the bear, which are strangers to Southern and Eastern Africa, and of which even Morocco and Algiers possess but a few representatives (perhaps only fossil bears in caverns),—a few of those animals which at present do not overstep the dominions of the desert, namely the African elephant and the hippopotamus; and with these, not the striped hyæna, which lives in Northern Africa and Upper India, but the spotted hyæna, the home of which is South and West Africa, the territory of the Nile, and Abyssinia. The Sicilian caverns show, also, a contact of South-European with true African types, which, owing to the interference of the Sahara, cannot be anywhere seen at this time.

These facts acquire the more importance when we add, that similar points of contact can be shown in Spain, from the period when the most prominent types of both faunas first existed. Moreover, it ought not to be overlooked that Cuvier searched for the nearest representatives of our diluvial fauna in Southern Africa, and even at the Cape; and that the fauna of Pikermi and Battavár, rich in antelopes, bears a distinct African character.

It cannot be stated at the present time, even conjecturally, in what way and through what causes the disappearance from Europe of the many groups of existing African forms, so long indigenous over our part of the world, was effected. M. Anca tells us, that even during the existence of the present faunas, there was a connection; and, as a first hint of such a connection, we have to fix our attention upon the submarine ridge reaching from Sicily to the opposite African coast, and which, Admiral Smyth states, encompasses the extensive plateaux of the "Adventure-bank," and the Skirki cliffs, which seem to be the submerged area of Virgil.

But, although the order of events which caused these changes appears as yet very obscure, we are nevertheless able already to distinguish amongst the present population of Europe, not only a number of certain independent groups of organic forms from which that present population of Europe has originated, but also to indicate the succession in which they appeared. The first group, still discernible, is that which we shall call the African; it was completely displaced long ago, and its last vestiges in Europe are shown to us by M. Anca. The second is the Northern group, the remains of which are still living on our high mountains, forming a higher zone above two others which occupy lower levels. These lower groups are, on the one hand, the western fauna, which we term the Lusitanian, the recognized types of which are the forms common to Northern Africa and Europe; on the other hand, the eastern fauna, which we may perhaps call the Asiatic, and which is subdivided into many members dependent on physical differences,—as, for instance, those which exist between the Caspian steppes and Asia Minor.

It is not our purpose to show here the relation of the various zones of special faunas in the European Seas; but we are bound to observe that the mollusca quoted above as being common to Vienna and Senegambia, as the *Trigonia anatina*, must have once undoubtedly inhabited some part of the present Mediterranean Sea eastwards of Sicily; and that they became tinct probably at the time of the diluvium, and never since have been le to recover their place. It is true, as Mr. M'Andrew teaches us, that any tropical species,—as, for instance, the *Cymba olla*,—favoured by the rrent, cross through the Straits of Gibraltar over to the North African asts; but they do not penetrate far enough, and besides, the character the Mediterranean fauna is quite different from that of Senegambia.

Climatal variations are generally considered the essential causes of all ch displacings of land and sea faunas and floras; and many distinguished turalists, influenced by the great effects they have witnessed of the uth wind on the glaciers in Switzerland, have been induced to attribute it the melting away of the formerly larger extents of those ice-masses. ius, also, they have arrived at the same result which, as we have seen, s been attained by the palæontologist, the geologist, and the animal geoapher, each following different roads, namely the conclusion that the hara, the source of the south wind, was once covered with water. On e heights of continental Europe a stronger climate might probably have en produced; but in a continent dissolved into an archipelago, as we n imagine it to have been at the time when the present Senegambian ell-fish lived near Vienna, a lower temperature, at least in the sea, could rtainly not have been produced, and the whole archipelago enjoyed unubtedly, notwithstanding the want of a south wind, a moderate seaimate.

Many questions and many doubts still force themselves on our mind; ut at all events we can at least already foresee the way to study through he creations of the present those of the past, and through which we may rrive at a more perfect understanding of the repeated changes of the organic world.

The Count Marschall of Vienna has kindly sent us the following excellent notice of Dr. James R. Lorenz's admirable and valuable work on the 'Physical Condition of the Gulf of Quarnero, and the Distribution of the Organic Beings living in its Waters:'—

This book, published at the cost of the Imperial Academy of Sciences, is based on the results of six years of assiduous local observations made by the author, who holds an eminent place amongst the younger generation of Austrian naturalists. The title in itself shows these investigations to stand in close relation with those made by Oersted on the Oeresund and by the late Edward Forbes on the Ægean and the German seas, especially concerning the distribution of submarine organisms (both plants and animals) within certain regions of depth and the influence of physical conditions on their modes of existence; while Sars, Asbjörnsen, and M'Andrew have merely brought under consideration the mode of distribution of marine animals, without a special regard for the physical conditions under the influence of which they exist. Dr. Lorenz's book, however, is in certain points of view essentially different from those by Oersted and Forbes. The physical conditions of the Gulf of Quarnero, which covers a surface of about one geographical degree square, are treated in detail in the first section of the book, which may, in itself, be regarded as a complete hydrography of this portion of the Adriatic. Such a thorough investigation of these conditions may be considered a real progress, to be expected from the rational use of a sequential method. What, after all, are the regions and zones to be distinguished in the horizontal and vertical distribution of organic beings but spaces, within whose limits the essential characters of these beings remain unaltered? Wherever these characters undergo decided alterations, or the hitherto prevailing types are superseded by others essentially different, a new region or zone must be said to begin. This constancy of character among the organic inhabitants within determined vertical or horizontal limits, could not take place if certain external circumstances were not vital conditions for a great many organic beings, whose existence can only be continued and propagated under a determinate combination of physical agencies or whose power of natural selection and its results (to speak in the sense of Dr. Darwin's hypothesis) is essentially dependent on these agencies. At all events, organic beings consociate in those spaces within which they find the means of satisfying their special conditions of existence. These conditions for marine organisms are:—the nature of the sea-bottom, the temperature of the sea-water, its saltness, its permeability to light, its pressure, undulations, currents, and tides; just the objects to be treated in a physical geography of the sea. The distribution of marine organic life can, of course, only be thoroughly understood by the aid of hydrography. This branch of science may however turn into profit the results of organographic investigations, as being indicative of certain hydrographical conditions, which, without them, could only be stated by means of a long series of observations, and must consequently, in certain cases, remain far behind the special purposes to be attained by them.

Professor Lorenz, in the course of his investigations, took great care never to lose sight of the intimate connection existing between hydrography and organography. The introductory part of his book begins with an exposition of the mode of action of each single agent. He proves the depth, generally considered, according to Edward Forbes, to be in itself a condition of distribution, to act only as a combination of other factors. In the following chapters the author discusses each of the above-named factors, in itself and in its connection with others, basing his comments on his own numerous observations in the Quarnero.

The factors depending on the solid basin containing the sea and the atmosphere in immediate contact with its surface,—that is, the geographical, bathymetrical, geological, and meteorological conditions,—are first brought under discussion. A very instructive map, partly of chromotypic execution, serves to illustrate the variations of depth and of the nature of the bottom, both in open sea and along the shores.

In the chapter on climatic conditions, in many respects depending on those of the neighbouring continental regions, the author expresses his remarkable views on the mutual connection between wind and weather, shows the origin of certain winds regulating the march of weather, and derives from their nature a series of typical atmospheric conditions (Bora, Scirocco, Maëstral, Tramontana, and Provenza weather), with their prognostics, courses, distributions according to seasons, etc. The explanation given by him of the "habitual Bora," with its characteristic blasts of wind (Repoli), is particularly of scientific and practical interest. According to Dr. Lorenz's observations, the north-east wind passing over the high and steep slopes of the Karst is innoxious in itself, whether it comes from inland regions, or originates over the plateau of the Karst by local compensation between two atmospheric currents different in density or temperature. It acquires only a dangerous intensity whenever a scirocco, blowing in opposite direction to or a little above it, presses it more or less violently against the plateau of the Karst and forces it into a narrower space. Besides this normal Bora, two other varieties of it, of non-dangerous nature and of different origin, are known to exist.

The waters of the Quarnero contain salt in an average proportion of 3·76 per cent., their density is =1·023 at the surface and =1·0275 at

20 to 40 fathoms depth; both these conditions vary with the seasons and the weather.

In the chapter on optical conditions, the author states the distinction between the specific coloration of sea-water and the tints due to reflection of surrounding objects; the dependence of the specific coloration on depth, purity, and transparency of the water (as proved by a great number of measurements); and the intensity and tints of light as it penetrates into greater or less depths. When discussing the undulatory movements, the author pays special attention to the nature and intensity of breakers, as determined by the conformation of the sea-bottom and of the shores; as also to currents, their velocities and depths, and their dependence on the direction and intensity of winds or on unequal distribution of atmospheric pressure and of evaporation.

Level-observations, continued during a series of years and occasionally far southward along the Dalmatian coast, have led our author to a number of very peculiar, and indeed unexpected results concerning the tides of the Quarnero. Within the eastern longitudinal half of the Adriatic, high water and low water take place only once in twenty-four hours, their times of beginning not retrograding daily with the culmination of the moon, but retarded only two hours in every month, so that within twelve months the tides return again to their original periods. The facts being at complete variance with those hitherto admitted, Dr. Lorenz thought proper to give a graphical representation of a long series of his personal observations by means of curves, which he calls "actiographical," as being indicative of the causes acting on tides. The average sea-level is chosen for a line of abscissæ: the curves rising above or sinking below the line mark the epoch and intensity of tides; their tracing (thick, thin, punctated, streaked, etc.) is indicative of the simultaneous state of weather and wind. Every diurnal curve bears the date of the corresponding day and lunar phases, and is partly accompanied by the corresponding barometrical curve. This synoptical representation of tides and causes acting on them, shows that none of the above-named factors, nor interferences, friction, and other causes of retardation, are the ultimate causes of this peculiar march of these tides, although they may modify it within precise limits. The ultimate cause may only be ascertained by tidal observations extended through the whole length of the Adriatic and the Mediterranean; the phenomenon itself is a duly-stated fact, and Dr. Lorenz has made it the basis of a tide-calendar for the Quarnero, with every connection for secondary influences acting on the times of beginning and the intensity of tides.

The physical part of Dr. Lorenz's book ends with the discussion of temperature as influenced in many ways by all the other factors. Nearly 200 measurements have been taken, either at regular periods, in determinate places, and in constant depths (surface, 10, 20, and 40 fathoms), or occasionally to serve for special purposes. The results of these observations are highly interesting. They give, not only the average temperature of water in the above-mentioned horizons, but also the progress of temperature within them during the course of each season. Their graphic reproduction by means of curves distinctly exhibits the retarded influence of seasons, the diminution of difference between the maxima and minima, and the general depression of average temperature with increasing depth (about 1° R. for each 10 fathoms). The influence of the sea-bottom, of fresh water, etc., on the temperature of shallows, is brought under discussion; and the affluent fresh waters are shown, by observations of temperature, to form a very thin but far-spread stratum on the surface of the heavier salt-water.

It may be inferred from this succinct analysis of the physical part of Dr. Lorenz's book, that it is, in itself, and independently of the organographical division, a highly valuable contribution to our knowledge of archipelagic hydrography. We must wish, therefore, to see the author pursuing the plan, traced out in his epistolary communications, for stating the essential, numerous, and practically interesting differences between the simple conditions of oceanic and the far more complicated ones of archipelagic hydrography. The organographical division begins with introductory remarks on the method of investigation and the way of discussing their results. It is proved to be more adequate and conclusive not to begin with the statement of regional limits, but rather to state regional maxima, from which the organic types most evidently consociated within the maximal strata may be pursued in ascending and descending directions as far as to their extreme limits. Animal and vegetable forms must not be promiscuously used for regional elements, as it has been done by Oersted and partly also by E. Forbes, the plants following, in their distribution, quite different laws from animals, the maximum of their diversity of forms and their total disappearance taking place in depths entirely different from those of animal organisms. The purpose of the method followed by the author in the description of each region is, to give a complete physiognomical and actiognomical idea of each of them as to their causes, so as to serve as points of comparison for future similar investigations,—a purpose not attainable from the majority of the hitherto published marine faunæ and floræ, these being generally mere enumerations of species.

The detailed descriptions begin with the marine plants of the Quarnero. Every region is accompanied by special details in respect to its physical conditions, founded on careful local investigations. By this method, the simple mention of the depth in which any organic being is living is quite sufficient to give an exact notion of the whole of the external agents under which it exists, and which, more or less, are determinative of its habitat.

Within every region of depth organic beings are consociated in distinct groups, as far as the conditions, not essentially connected with depth and consequently diversely distributed within one and the same stratum of depth, as the nature of the sea-bottom, currents, and, in higher strata, undulatory movements, affluence of fresh water, etc., are more or less favourable to their development.

These groups distinguishable within each region are called "*facies*." The author enumerates forty-one of such facies within the six vegetable regions of the Quarnero, and names them according to the genus prevailing among them, Callithamnetum, Cystoseinetum, etc.

A table of distribution enumerates the vegetable species in systematic order, each with the corresponding number of its region, and its horizontal range in other seas. A comparative synopsis of the vegetable regions of the Quarnero and of those of other seas, shows Oersted's book on the Oeresund to be still the only extant work on marine plants and their distribution which may afford profitable comparative results.

The seven regions and thirty-two facies of the Quarnerian animals are treated on the same plans as those for vegetables, both of them standing frequently in mutual dependence.

The table of distribution of animals gives a comparative view of the depth at which the same species have been found in other seas by E. Forbes, Oersted, and M'Andrew, and of their horizontal range, as far as yet ascertained.

Also for the animals a comparative synopsis again proves the results obtained by E. Forbes and Oersted to be the only ones fit for profitable comparison.

The elaborate data from which the laws of vertical distribution of marine organisms may be inferred with any degree of security being so extremely scarce, we must admit Dr. Lorenz's book to be a highly valuable contribution to this branch of science; the more so as he, working on the few classical investigations of his precursors, has really added new riches to our scientific stores.

This book, although not directly connected with geology and palæontology, as E. Forbes's investigations were in their time, nor published with any view to the practical purposes of propagation and acclimatization, may be profitable notwithstanding to each of those branches, as it offers a rich store of thoroughly discussed facts whose influence on extinct animal forms was certainly not less than it is still on those now living.

Even plain good sense, unassisted by science, can comprehend how from investigations of this nature, that only by following the still-neglected paths of physico-organographical researches profitable results may be achieved concerning the rational culture and multiplication of useful marine productions.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Dudley Geological Society.—In a paper read before the Dudley Field Club, Mr. John Jones, of Gloucester, has described some flint-flakes and the deposit in which they were found by Mr. E. Witchell, of Stroud.

In an excavation for a reservoir on the brow of the Oolite hills at that place, the superficial clay charged with land and freshwater shells rests apparently on land-slipped masses of Oolites and subjacent rocks, the total thickness of the clay being from 15 to 20 feet, and the elevation of the deposit 700 feet above the sea. The clay bed is said to be divided into an upper, middle, and lower portion. It is from the middle portion Mr. Jones records "flint-implements with cutting-edges (*i. e.* flint-flakes), carbonized wood, Oolitic stone changed in colour by the action of fire, the bones of animals, a portion of a deer's antler, apparently that of the red deer, and what, from the description of the workmen, who had not cared to preserve it, was probably a boar's tusk, all in close proximity." The shells found in the clay are various species of *Zonites*, *Helix*, *Pupa*, *Succinea*, etc.; such, as Mr. Jones says, have been found fossil at Grays, Copford, and Clacton, and as he gives a list of the mammalia found at those places, we presume he is disposed to infer the same age for the Stroud clay: a conclusion we do not see borne out by the character of the flint-flakes, which are of prehistoric, but not geological age, according to the opinion of Mr. John Evans, who has inspected them. Mr. Jones's method of comparison with the organic remains from Grays and other beds for the age of this deposit is very curious, but in the case of mollusks is not, we think, practicable. The circumstances are, however, well recorded, and the author has worked together very nicely all the facts which have come to his knowledge in support of his views. The locality from which these relics have come would, if worked in an antiquarian point of view, afford, we think, many more interesting details, and we are glad to hear the proprietor intends carrying on further excavations. The paper is, like many others by Mr. Jones which we have already noticed, carefully worked out, and one properly adapted for the discussion of a field-club.

Manchester Geological Society.—Mr. Binney communicated to the Society a section of the drift deposits near Rainford, kindly furnished, with some fossil shells, by Mr. Bramall. That gentleman had forwarded him a section of the beds sunk through and the fossils found in them, just the kind of information which it is desirable for gentlemen to transmit to the Society. It is only by such information that we can hope to obtain a thorough knowledge of the drift deposits of Lancashire. He trusted that many other members would forward similar sections. The pit is near the Lancashire and Yorkshire railway, and the following beds were met with in sinking the shaft there:—

	yds.	ft.	in.
Soil	0	1	6
Marl	11	1	6
Loam	5	0	0
Wet Gravelly Clay	5	1	6
Quicksand	7	0	0
Gravelly Marl	1	0	0
	30	1	6

At a depth of 25 yards from the surface, in the wet gravelly clay and the sand, the *Turritella terebra*, *Fusus Bamfius*, *Nassa reticulata*, *Cardium edule*, *Tellina solidula*, *T. tenuis*, and fragments of other shells were found. He did not know the level of the place above the sea, but he should not estimate it much above 200 feet; and he had great pleasure in exhibiting to the meeting the beautiful and perfect shells which Mr. Bramall had been so kind as to send him.

2. Mr. Binney presented two maps of the parish of Manchester, coloured geologically by himself,—one showing the drift deposits, and the other the older stratified rocks found lying under such beds. They were made, in 1861, to illustrate a paper read by him before the Geological Section of the British Association. These maps he considered more as outline than complete maps, but they would be useful to show what was known of the district prior to the visit of the Geological Survey. All the particulars, both as to the drift and the older rocks, had been previously communicated to the Society many years ago, except in some few instances, where fresh borings and excavations had since been made.

In his paper entitled "Notes on the Lancashire and Cheshire Drift," read before the Society on the 23rd day of December, 1842, an abstract of which was printed in the Annual Report of the Society for 1843, he gave a classification of the beds into three divisions of lower sand and gravel, till or boulder clay, and upper gravels and sands, with occasional beds of till or boulder in them. Besides these three deposits, he described a fourth, in the gravels and sands found in the beds of the valleys and low lands adjoining rivers and brook courses, and evidently derived from the first-named deposits, such valley sands and gravels being formed during the erosion of the valleys through the three more ancient beds.

With respect to the older rocks, he said that when he came into the district some twenty-five years ago, the local geologists always considered the four-feet coal of Bedford, Worsley, Bury Lane, and Pendleton, to be the same as the Bradford four-feet.

In the sinking of Messrs. Knowles's shaft at Agecroft, the following section, kindly communicated by Mr. James Knowles, was met with:—

	yds.	ft.	in.
Soil, Sand, Clay, and Soft Metal	15	2	0
Rock	11	2	0
White Earth	1	2	0
Coal	1	0	1

	yds.	ft.	in.
Chitter	1	0	2
Rock	34	0	0
Blue Leys	5	2	0
White Earth	1	2	0
Iron Band	0	0	3
Rock Warrant	3	0	0
Rock Bands	3	0	0
Rock	3	0	0
Blue Leys	5	0	0
Iron Bands	0	0	3
Black Stone	0	0	5
Rock	2	0	0
Blue Leys	2	0	0
Black Bands	0	0	6
Rock	0	2	6
Warrant Earth	2	0	0
Rock Warrant	0	2	0
Blue Leys	1	2	0
White Earth	3	1	0
Black Bass	0	1	0
White Earth	1	2	0
Coal	0	0	6
Warrant Earth	2	2	0
Rock	0	2	6
Blue Leys	1	0	0
Rock	0	2	0
Blue Leys	5	2	6
Black Bass	1	0	0
White Earth	1	0	0
Black Bass	0	1	3
COAL, FOUR-FEET	1	2	0
	116	1	11

:hough the common opinion was that the two coal seams were the , there was not much evidence adduced in support of it. On taking trata immediately above the Four-feet coal at Agecroft, Pendleton, St. George's Colliery, Rochdale Road, Manchester, the two last-named s being about 2½ miles apart and the nearest we can find, there is derable difference, both in the beds and their organic remains, as wil. ident from the following sections :—

AGECROFT.

	yds.	ft.	in.
Blue Leys	5	2	6
Black Bass	1	0	0
White Earth	1	0	0
Black Bass	0	1	3
Coal	1	2	2

PENDLETON.

	yds.	ft.	in.
Blue Leys	7	1	0
Black Bass	0	1	0
Very Black Bass	0	0	8
Ironstone	0	0	2
Impure Cannel	0	0	3
Cap Coal	0	0	10
Fire Clay	0	1	4
Coal	1	1	0

The Agecroft section was about half a mile to the north-west of the Pendleton one. The same fossil fish remains, and the *Anthracoptera Browniana* of Salter, are met with in the impure cannel, black bass, and ironstone of both mines, although in much less abundance at the former than the latter.

Now at St. George's Colliery, Manchester, about 2½ miles in a straight line from Pendleton Colliery, the following is a section of the strata immediately above the four-feet coal:—

	yds.	ft.	in.
Rock Bands	3	2	0
Hard Gray Rock	5	0	0
Coal, called Nine Inches . .	0	0	6
Black Sod, Rotten	0	1	0
Impure Cannel Coal	0	0	6
FOUR-FEET MINE	1	0	6

Not only is there a great difference in the nature of the deposits, but there is an equal difference in their fossil organic remains, few, if any, of the fishes being met with at Bradford which were so abundant at Pendleton. Until the sinking of the Patricroft pit by Messrs. Lancaster, and the proving of the Pendleton four-feet coal there, it was not easy to be convinced that the Bradford and Pendleton seams were the same; but when the author saw the red ironstone at Patricroft, he immediately identified it with a similar bed seen on the banks of the Medlock, below the brewery in Beswick. Now the last-named instance lies 366 yards above the four-feet coal of Bradford, as can be proved in the river section of the Medlock, between Beswick and the old ford across the river, just below the iron bridge near Philip's Park, where the "four-feet" outcrops. The distance is 1100 yards, and the dip of the strata, on an average, 1 in 3; so that will give 366 yards between the two strata. At Patricroft, the distance in the sinking between the four-feet coal and the red ironstone was 378 yards. From this, 20 yards has to be deducted for the dip of the strata, leaving 358 yards as the thickness; so one seam is within 10 yards' distance of the other,—no great variance in 5 or 6 miles.

By looking at the map it will be seen that the Trias covers the upper coal-field on its dip at Ardwick, and no traces of the Permian beds, which are known to be found under the south-east of the city, are shown at the surface. There is little doubt but that both the Trias and Permian beds rest unconformably on the upper coal-measures here, but they cannot be seen. Some time since, Mr. Mellor was so kind as to show him a soft red sand without pebbles, very like the Vauxhall sand, which had been met with in driving a tunnel to the dip of the Ardwick limestones. At first he was inclined to consider this sand as Permian, but he has since come to the conclusion that it is Trias, as no Permian marls are found above it. He had given, he said, twenty-five years to investigate the geology of Manchester, and the two maps, imperfect as they were, are the result of his labours. Younger geologists must take them in hand and improve upon them. There was plenty of work to be done before the geology of the district, six miles around the Manchester Exchange, would be all well known and correctly laid down. He hoped that the structure of the ground upon which the city stood would attract the attention of the members.

Mr. E. Hull said it was an excellent local map, and conveyed a very proper and correct notion of the general structure and principal features of the district of Manchester. He took a different view from Mr. Binney

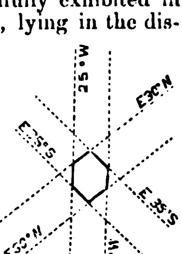
IDEAL SECTION OF LA SALEVE, FROM A DIAGRAM BY JOHN RUSKIN, ESQ., F.G.S.

S. J. Mackie del.

n one or two points, principally as to the formation to which the sandstone near the Ardwick limestone beds belongs. He could not see what objection there should be to insert a little strip of lower red sandstone of the Permian formation there. This he has done himself in the map published by the Geological Survey, and he thought the reasons for doing so outweighed those for the opposite course. He also considered that the Irwell Valley fault ought to be continued to the Mersey, at Heaton Mersey; and the eastern boundary fault of the Manchester coal-field to Stockport. Also, that there was a second bed of boulder clay lying above the sand and gravel; but in his general views on the subject of the drift, he fully concurred with Mr. Binney.

NOTES AND QUERIES.

The Granite Rocks of Donegal is a subject that has been taken up in a determinate and able manner by Mr. Robert H. Scott, the Secretary of the Geological Society of Dublin, and several valuable papers on it have been read by him, and have been published in the 'Dublin Quarterly Journal of Science.' He points out the very remarkable fact that the so-called igneous rocks of Innishowen are contemporaneous with the sedimentary rocks of that district. "In the north of Innishowen," he says, "the chief rocks observed were grits, crystalline limestone, mica slate, and a variety of greenstones and syenites, passing by insensible gradations into the two distinct types of syenite of Ardara and Horn Head. The whole of these rocks are contorted considerably about Culdaff, and from that to Malin Head they exhibit a consecutive section, of which the dips increase as you go westward, the beds being nearly horizontal (dip 20° to 25° E.) at Culdaff and along the shore towards Glengad Head, and consisting of grits, interstratified with igneous rocks. . . . It is very remarkable that the igneous rocks, to which allusion has already been made, as being found in great abundance in the county, in Innishowen, are undoubtedly contemporaneous with the sedimentary rocks of the district. This fact is observable along the coast, but it is noticeable in the most striking manner between Buncrana and Carndonagh, about five miles from the former place,—the whole of the hills lying between Slieve Snaght and the Raghtin mountains being composed of alternating beds of quartz rock and syenite, dipping at a low angle to the eastward. This is beautifully exhibited in the mountain of Binmore or the King of the Mintiaghs, lying in the district called the Barr of Inch, close to the Mintiagh lakes. This hill, with its consort, the Queen, form a very striking feature in the landscape, when seen from any point in the northern part of the county. . . . These hills and the mountain Bulbin are terraced like the trap hills of Antrim and the coast of Argyllshire; but on a close examination, it is found that, though the conclusions drawn from the terraced form are further borne out by the fact that all the beds are columnar, yet they consist of alternate beds of quartz rock and syenite, as before described. The columnar structure of the former is due to the simultaneous development of three series of joints, inclined to each other at angles approaching those of a regular hexagon. These joints are all of them traceable in other parts of the county; but it is only here that they assume a development of such equal importance.



Joints in King of the Mintiaghs.

"It may here be remarked that the types of igneous rock, which have here been deposited contemporaneously with the sedimentary strata, are found to be very similar to those of the intrusive rocks of other parts of the county, *e. g.* of Doonan Hill, close to the town of Donegal.

"On passing west from Buncrana towards Dunaff Head, through the Gap of Mamore, it is found that, as we approach the granite at Urrismenagh, the dip of the beds increases from 45° to nearly absolute verticality. The granite of Urrismenagh does not present many features of interest to the mineralogist, as the rocks in immediate contact with it are quartzose, and therefore unlikely to yield accidental minerals. . . . The chief point which is noticeable about the neighbourhood of Dunfanaghy is the extreme development of a highly crystalline syenite, containing a very large proportion of titaniferous magnetic iron. The octohedral crystals of this mineral are very noticeable on the weathered surface of the rock."

HYBODUS AND OTHER FOSSILS.—Dear Mackie,—A few notes on 'Geologist,' No. 67.—P. 241. Many specimens of shark-jaws much like, if not the same as, *Hybodus basanus*, certainly in similar state of preservation and matrix, occur in the *Wealden* beds near Hastings, probably in the middle portion of the Hastings sand series. Mr. Moore, of Hastings, and Mr. Beckles, have collected several specimens. The Wealden beds below the Perna bed (bottom of the Lower Greensand) in the Isle of Wight present about 100 feet of thickness above the equivalent of the Hastings sand; therefore, if occurring there in the equivalent of the Hastings series, the Hybodus may have been found perhaps on the shore not far from the junction with the Lower Greensand; nevertheless it may be truly a fossil from the latter.

Page 243, etc.—"Lias Bone-bed." You might as well give the proper term to this at once, "*Rhætic* Bone-bed" (or "one of the bone-beds of the Upper Keuper"). The Rhætic shales at Linksfield, near Elgin, are also rich with *Hybodus*. The Linksfield shales, at first thought to be Wealden, were referred by Morris to the Great Oolite, but are now regarded as Rhætic. See my monograph on Fossil Etheriæ, p. 77. *Sphenonchus Martini*, Ag., also from Linksfield, is regarded by Ogilvie and Charlesworth as the "frontal spine" of *Hybodus*.

Page 245.—In your list, after Morris, you should have kept *H. striatulus* to the Wealden. It would have been well if you had separated teeth from spines in the list.

Page 255.—"*Rhinoceros Etruscus*." I do not see this mentioned in M. Desnoyers' Memoir.

Page 267.—Why didn't you notice the fact of Sir P. Egerton and Mrs. Smith's specimens of *Dolichosaurus* being parts of one and the same specimen? See Dixon, Foss. Suss. p. 388, Owen's Monog. Cret. Rept. 1851, p. 22, and Medals, p. 712.

Page 268.—"Lower Greensand Reptiles." I believe that the little crocodile figured and described by Owen, Monog. 1851, p. 45, as in Saul's collection and from the "Lower Greensand, near Hastings," was from the *Wealden*. I saw it in Saul's collection.

Page 270.—"Lapis frumentarius." "Lapides frumentarii" are pieces of Nummulitic limestone, Alveolina limestone, and stone full of other Foraminifera, as the case may be, with different old authors. The sections of the Nummulites present occasionally seed-like appearances as well as small leaf-like objects, which latter gave rise to the terms "Salicites," "Daphnis," etc.; whilst the Alveolinæ, etc., were thought to be rice and other grain, as millet, fescue-grass, etc. Hence the names "Phacites," "Seminales lapides," "Lentes lapideæ," "Lapides cumini, frumentarii,"

:. ; besides "Lapides circulares," "Nummi lapidei," diabolici, "Nummularii lapides," "Lapides numismales," etc., for Nummulites. See esner, Langius, Scheuchzer, Mercatus, etc. The last-mentioned of these d observers has the following remarks on some "Lapides frumentarii," "Pœcilospermi," as he terms them, in his 'Metallotheca Vaticani' Iichaelis Mercati Samminiatensis Metallotheca, opus posthumum, studio M. Lanciscii: Romæ; fol. 1719).

At page 285, "*Pœcilospermos*. Confertus siliquis agrestis cumini corculatis, interponit alias in gyros convolutas, quales sunt Medicæ; nonullas bifidas specie coluteæ, rimam agentes, per quam semina minuta osnduntur." The locality of this specimen is not given; the figure inditess *Rotalia Beccarii*, *Peneroplis* (?), etc., in the stone.

At page 286, "*Pœcilospermos alius*. Huic sunt ferulacei generis semina, eniculi, anethi, multaque minuta, quædam tritici, aliqua in gyros collecta, ualia diximus Medicæ, adjectis insuper hirculis, cauliumque sarmentis." his specimen is of a dull yellow colour, as is also the foregoing; the loality was not known. The Foraminifera in it seem to be Miliolæ, Rotaæ, etc. Other specimens from Verona are then mentioned as being full f wheat, and it is observed, "ut videatur in eo necessitas vitæ nostræ ludirium Naturæ debuisse."

The title of Langius's book, in which the *Lapides frumentarii* are menioned and figured, is:—"Caroli Nicolai Langii, Lucernens. Helvet. Phil. t Medici, Acad. Cæs. Leopold. Nat. Curioss. German. et Physio-Crit. Senens. Historia Lapidum Figuratorum Helvetiæ, ejusque viciniæ, in uâ non solum enarrantur omnia eorum Genera, Species et Vires æneisque abulis repræsentantur, sed insuper adducuntur eorum loca nativa in quibus reperiri solent, ut cuilibet facile sit eos colligere, modo adducta loca adire libeat." Venetiis, MDCCVIII.

At p. 69, etc., are described certain specimens which are figured on Plate 18; namely,—"Salicites Helveticus, niger, foliolis candidis" (a piece of Nummulite limestone). "Lapis frumentarius Helveticus, niger, semina melonum cumini cum conchitulis albis referens" (a piece of Nummulitic limestone). "Lapis frumentarius Helveticus, cinereus, semina melonum anisi fœniculi referens" (a piece of Nummulitic limestone). "Cenchrites" (Oolitic rock?). "Meconites" (Oolitic rock?).

Page 270, "Lapis piriformis" or "pyriformis."—Any *pear-shaped* curious stone would be sufficient for this. I have an excellent flint one from the Chalk.—Yours truly, T. R. JONES.

15, *Terrace, Yorktown, July 14th*, 1863.

[I used the term Lias Bone-bed as being the first given to it, and because I am not yet prepared to admit the deposit as a portion of the Keuper. I do not however wish at present to dispute its assignment to that formation. I am not a believer in palæontological determinations of the geological age of strata, and admitting the fossil organic forms in the Bone-bed to be Rhætic, it seems to me that they were cut off out of living existence by the commencement of the Lias deposits,—that is to say, the commencement of the deposition of the Lias strata was the period of the destruction of the Rhætic fauna. Does the presence of Rhætic forms under such circumstances take the Bone-bed out of its proper stratigraphical relationship to the Lias? Such are the reasons why I have called it Lias Bone-bed. I did not notice the Egerton *Dolichosaurus* as a portion of Mrs. Smith's specimen, although I was well aware Professor Owen had done so in his 'Monograph of Cretaceous Reptiles,' for the reason that Professor Owen records Mrs. Smith's specimen as from the Middle Chalk, while Sir Philip's specimen in the British Museum is decidedly Grey Chalk. Mrs. Smith's collection being no longer accessible to inspection, I preferred to leave the reputed association unnoticed. With regard to the "Lapis pyriformis," it seemed to me that many of the fossil sponges might be noticed under such a term; but it also seemed possible some of the larger flint-implements might have been so termed; and I thought the point worth noting.—Ed. Geol.]

New British Mammals.—The following mammalia have been recorded as British since 1853, the year of the publication of the 'Bibliographia Zoologiæ' by the Ray Society, as new or as found within the British area for the first time, or in a deposit from which not previously recorded:—

Bos frontosus, Nilsson, sp. Recorded by Mackie as British, in 'Geologist' (1862), Vol. V. p. 441, Pl.

Bubulus moschatus, Owen (Pallas, sp.), *Pleistocene* (Lower Level Drift), Maidenhead, Berkshire; Quart. Journ. Geol. Soc. (1856), vol. xii. p. 124, fig. 1–6.

Canis, sp., Owen, *Red Crag*, Woodbridge, Suffolk; Quart. Journ. Geol. Soc. (1856), vol. xii. p. 227, fig. 22.

Canis, sp., Owen, *Red Crag*, Woodbridge, Suffolk; Quart. Journ. Geol. Soc. (1856), vol. xii. p. 227, fig. 21.

Cervus dicranocerus, Owen, *Red Crag*, Sutton, near Ipswich, Suffolk; Quart. Journ. Geol. Soc. (1856), vol. xii. p. 224, fig. 14–17.

Dichobune ovina, Owen, *Upper Eocene Marl*, Isle of Wight; Quart. Journ. Geol. Soc. (1857), vol. xiii. p. 254, pl. viii.

Dichodon cuspidatus, Owen, *Upper Eocene*, Isle of Wight; Quart. Journ. Geol. Soc. (1857), vol. xiii. p. 190, pl. iii.

Elephas (all the British species), Falconer, in Quart. Journ. Geol. Soc. (1858), vol. xiv. p.

Equus (*Hipparion*?), sp., Owen, *Norwich Crag*, Norwich; Quart. Journ. Geol. Soc. (1856), vol. xii. p. 223, fig. 130.

Equus plicidens?, Owen, *Red Crag*, Bawdsey, Suffolk; Quart. Journ. Geol. Soc. (1856), vol. xii. p. 223, fig. 12.

Felis pardoides, Owen, *Red Crag*, Newbourn, Suffolk; Quart. Journ. Geol. Soc., vol. xii. p. 226, fig. 19.

? *Hyænodon*, Owen (carnivore allied to, and Pterodon), *Red Crag*, Woodbridge, Suffolk; Quart. Journ. Geol. Soc., vol. xii. p. 227, fig. 20.

Mastodon (*Tetralophodon*) *Arvernensis*, Falconer, *Crag*, Suffolk; Quart. Journ. Geol. Soc. (1857), vol. xiii. p. 331, pl. xii.

Megaceros Hibernicus, Owen, *Reg Crag*, Felixstow, Suffolk; Quart. Journ. Geol. Soc. (1856), vol. xii. p. 226, fig. 18.

? *Microlestes*, Owen (small vertebræ), *Triassic*?, Frome, Somerset; Quart. Journ. Geol. Soc. (1860), vol. xvi. p. 493.

Phocæna, sp., Owen, *Red Crag*, Bawdsey, Suffolk; Quart. Journ. Geol. Soc. (1856), vol. xii. p. 228, fig. 23.

Plagiaulax Becclesii, Falconer, *Purbeck*, Purbeck; Quart. Journ. Geol. Soc. (1857), vol. xiii. p. 278, fig. 1–14.

Plagiaulax minor, Falconer, *Purbeck*, Purbeck; Quart. Journ. Geol. Soc. (1857), vol. xiii. p. 281, fig. 15.

Pliolophus vulpiceps, Owen, *London Clay*, Harwich; Quart. Journ. Geol. Soc. (1858), vol. xiv. p. 54, pl. ii. iii. iv.

Prorastomus sirenoides, Owen, *Tertiary*, Jamaica; Quart. Journ. Geol. Soc. (1855), vol. xi. p. 541, pl. xv.

Rhinoceros hemitæchus, Falconer.

Rhinoceros Schleiermacheri?, Owen, *Red Crag*, Wolverton, Felixstow, and Sutton; Quart. Journ. Geol. Soc., vol. xii. p. 218, fig. 1–7.

Spalacotherum tricuspidens, Owen, *Purbeck*, Durdlestone Bay, Dorset; Quart. Journ. Geol. Soc. (1854), vol. x. p. 426, fig. 9–12.

'ereognathus ooliticus, CHARLESWORTH, sp., *Great Oolite*, Stonesfield, described by OWEN in Quart. Journ. Geol. Soc. (1857), vol. xiii. p. 1, pl. i.

ts antiquus, OWEN, *Red Crag*, Ramsholt, Suffolk; Quart. Journ. Geol. Soc. (1856), vol. xii. p. 223, fig. 11.

ts palæochærus, OWEN, *Red Crag*, Sutton, Suffolk; Quart. Journ. Geol. Soc. (1856), vol. xii. p. 223, fig. 10.

ıpirus priscus, OWEN, *Red Crag*, Sutton, Suffolk; Quart. Journ. Geol. Soc. (1856), vol. xii. p. 233, fig. viii. viii.*a*. ix.

riconodon mordax, OWEN, *Purbeck*, Durdlestone Bay, Dorset; 'Palæontology,' 2nd ed. p. 351.

iphius, OWEN, *Red Crag*, Felixstow (*Dioplodon*, Gervais), Suffolk; Quart. Journ. Geol. Soc. (1856), vol. xii. p. 228, fig. 24.

It would be very desirable to make this list as complete as possible, and ›tices from our readers of any omissions would oblige.—S. J. MACKIE.

FOOTPRINTS IN THE CAMBRIAN (?) SLATES.—The readers of the 'Geogist' will no doubt remember the announcement by Mr. John Taylor, in ıe 'Geologist' for September, 1862, of his discovery of what he regarded reptilian footprints in the Manx Cambrians at Dalby, near Peel, and ıe controversy to which that discovery gave rise. Without attempting review that controversy in detail, I may say that while Mr. Taylor mself asserted the ichnolitical character of the imprints he discovered, in her quarters the most diverse opinions were expressed respecting them. ›me thought that they might be specimens of some gigantic species of ıgula; others denied their organic origin altogether, and regarded them nodules, which are found occasionally occurring with a certain degree of gularity; others again, and these were by far the more numerous class, ›clined to express any decided opinion respecting them, the character ıd amount of the evidence produced by Mr. Taylor not being, in their dgment, such as would warrant the forming a definite opinion on a subct of such great difficulty. And so, with a general feeling that this disıvery did possess a certain amount of palæontological value, and yet with conviction equally general that it was almost impossible either to fix the nount of that value or make any practical use of it, this discovery of otprints in the Cambrian Slates of the Isle of Man has remained in ›eyance for nearly a year, waiting till more satisfactory evidence should ırn up in other quarters in the Isle of Man or elsewhere. This evidence am now able to furnish, and that, too, in such abundance and of such a ›scription, that I believe it is now quite possible to arrive at a perfectly ıtisfactory conclusion respecting the real nature and palæontological value these much-disputed "footprints." Having recently come to reside at axey, and knowing that at several points along the neighbouring coast ıe rocks furnish the most decisive proofs of a shallow-water origin, I set yself to examine carefully these localities, in order to see whether they ould furnish that further evidence which I believed necessary to the ıtisfactory settlement of the question respecting the nature of the supposed ›otprints. My search has at length proved eminently successful. One of ıese localities, Laxey Bay, yields these "footprints" in great abundance. his bay, one of great width but of inconsiderable depth, is backed throughıt almost the whole of its extent by tall precipitous cliffs, rising out of ıe water at an extremely high angle to a height of from 80 to 200 feet. ome of these cliffs at the north end of the bay, and contiguous to the old illage of Laxey, have been quarried for building purposes, but not to any reat extent, and almost the whole of the picturesque scene remains in its atural condition, untouched by human hand, and overgrown with golden orse and tufts of waving ferns.

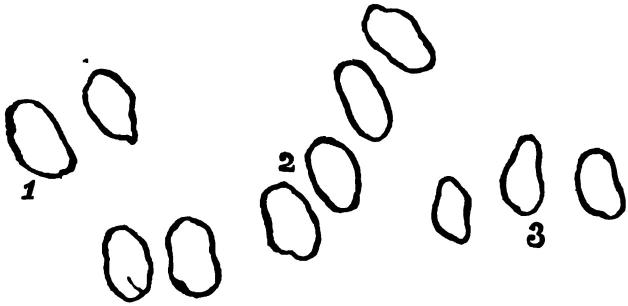
Starting from a point near the village, and proceeding in a south direction along the margin of the bay, we see the slates which compose the cliffs on our right, and the broken jagged rocks over which we scramble, covered with the most beautiful series of ripple-marks it has ever been our lot to see. Layer after layer, for hundreds of yards, as they crop out from below each other, is covered with these hieroglyphs of the past. And what adds considerably to their interest is, that the *pattern* of these ripplings is almost infinitely varied, scarcely any two surfaces being exactly alike in its markings. But these splendid ripple-marks are not all of interest that these slates contain. Studding the surface of the rocks, and among the ripplings I have alluded to, are *numberless* impressions of the same kind as those discovered by Mr. Taylor at Dalby. To what extent these impressions may be found, I am, as yet, unable to say. I have already traced them for a distance of about half a mile, throughout the whole of which they are found continuously both on the rock laid bare by the quarrymen, and also on the face of the untouched cliff.

In shape these impressions are of an irregular oval form, the breadth usually somewhat more than half the length. In size they are generally about nine or ten inches long by about five or six inches wide; but they are often found of not much more than half that size, and in several instances I have seen them of the enormous size of eighteen inches long by ten inches wide! I have presented to the Manchester Museum a slab containing an impression of this extraordinary size, which in the rock formed one of a group of three.

In substance they are generally somewhat softer than the rock in which they are enclosed, so much so, in fact, that it is no unusual thing among the rocks lying between high- and low-water mark, and hence, of course, subject to the direct action of the sea, to find slabs with the fossil footmarks, more or less washed out of the rock, and the matrix presenting the appearance of a deep water-worn hole. Above high-water mark they are strongly coloured with iron—a circumstance which enables the seeker to distinguish them with great facility, as they show with great distinctness upon the weathered light-grey face of the cliffs. Their faces also are usually thickly studded with pyrites and fragments of quartz, etc., of a rounded form: these are not merely coated over the surfaces of the impressions, but are in great part enclosed within their substance, so that when you pick out one of them with the point of your chisel, it leaves behind it a deep indentation. This accounts for the curiously pitted appearance of many of the impressions.

With respect to the order in which these imprints occur, I regret that I have not *now* the opportunity of entering into such minute particulars as should enable the readers of the 'Geologist' to judge of their nature for themselves. The distance over which these imprints are known to extend, and the fact that they are the footmarks not of one but of a great number of animals, while facilitating, from a personal inspection, our arrival at a satisfactory conclusion respecting their nature, greatly increase the difficulty of giving within anything like a reasonable space a clear idea of the order of their occurrence in this locality. In as few words as possible, however, I will try to indicate one or two of the more prominent features of this part of the subject, leaving a fuller detail for a future communication.

Occurring in great numbers and over a very considerable area, these impressions seem, at first sight, to be scattered over the face of the rocks without the least order or regularity; a more careful examination, however, reveals an amount of regularity in the order of their occurrence which not merely demonstrates satisfactorily their organic origin, but indicates to a great extent the nature of the animal that formed them. In pursuing this examination it is soon found that they most frequently occur in groups of one or more pairs, usually in a single group of two, Fig. 1; but also occasionally in a series of such groups, for example, as in Fig. 2, which is a reduced outline of a portion of one of the slabs I have inspected. Another frequent group is one of three impressions, arranged as in Fig. 3.



Impressions in the Cambrian (?) Slates.

In some instances the markings forming these groups are of the largest size yet discovered,—18 inches long by 10 inches broad. I am inclined to think, however, that this particular arrangement of the markings into a group of three is merely an example of a *double* group of two, the fourth impression being probably hidden by the overlying rock, or missing from some other cause.

Mr. Taylor, in his account of his discovery of similar fossil footprints at Dalby, considers them to have been formed by a tortoise-like chelonian, and founds his opinion partly upon the fact that the footmarks he discovered strongly resembled the Canadian *prolichnites* figured in Owen's 'Palæontology,' and which were, in the first instance, supposed to have been formed by a chelonian; and partly upon the fact, that upon the slab in his possession the impressions were "about 4 inches on each side of a straight line, alternately on this side and on that." This reference of these markings to a chelonian origin is not, I believe, borne out by later researches. Professor Owen (quoted by Murchison, 'Siluria,' first edition, page 205), in consequence of the discovery of better specimens, now refers them to crustaceans, an opinion confirmed by the discovery of similar crustacean markings by Professor Harkness in Roxburghshire in 1855. "These curious impressions are not at all unlike those for larger prints which Professor Owen has so well described, and which were found by Sir W. E. Logan in the Potsdam sandstone of Canada. In this case, however, it would appear that a single pair of legs successively produced the imprints (not four, or five, or more, as in the Canadian tracks), and they are most likely to have been made by an animal swimming with difficulty in very shallow water, such as Professor Harkness proves to have been the condition of the locality from physical evidence" ('Siluria,' page 168, edition 1859). From this it would appear that the original supposition that the "*Prolichnites*" were the tracks of chelonians, has not been borne out by more recent discoveries, but that they are now referred to a shrimp-like crustacean, analogous to the *Hymenocaris* of the Lingula flags. Further, with reference to their arrangement in single prints "alternately on each side of a straight line," as Mr. Taylor states them to occur upon the slab in his possession, throughout the whole of my examination of the markings at Laxey,—and I have examined hundreds of specimens,—I have not been able to identify distinctly any such arrangement. On numerous slabs, however, were I to cover up half the marked surface, the markings would assume an appearance very similar to that described by Mr. Taylor; and in this way, particularly as by his own account the exposed surface was very limited in extent, I should account for the appearances described by him.

But although I have not found these tracks occurring in the order described by Mr. Taylor, I have found them occurring in an order very similar to that described in the passage from the 'Siluria' quoted above. The arrangement most perceptible is *in groups of two*, and these groups are often found occurring in clusters, as would result from the "animal swimming with difficulty in very shallow water." That the water in this locality was very shallow we have abundant evidence. Hence I do not agree with Mr. Taylor in attributing these fossil footmarks to a chelonian, but, with the evidence at present before me, I am inclined to refer them to a crustacean.

In conclusion, I would respectfully submit to the scientific world the propriety of making a thorough investigation of this important discovery. The discovery of these tracks is an extremely rare occurrence, and their true nature is consequently proportionably mysterious to geologists; it follows therefore that their discovery in such remarkable abundance, and under such favourable conditions, is a fact of very considerable importance; and I trust that this announcement of their existence, necessarily brief and imperfect, will not pass unnoticed, and that the matter will receive a careful and thorough examination at the hands of competent men. If anything I can do will be of service in this inquiry, either by corresponding on the subject, by forwarding specimens, or by personally acting as guide over the locality, I shall be very glad to be of use.

I shall be obliged if you will insert the enclosed communication in your August number, as the summer is getting on, and I am anxious to attract some of the English geologists over to examine the tracks.—Yours sincerely, THOMAS GRINDLEY.

Laxey, Isle of Man, July 24th, 1863.

ANCIENT CANOE.—A remarkable discovery has been made by some workmen in draining the fields which were formerly covered by the waters of Giggleswick Tarn, Yorkshire. At the depth of some five feet they struck upon an ancient canoe, which an eminent antiquarian, who has examined it, has pronounced to be Celtic, and probably not less than two thousand years old. It has been hollowed out of the trunk of a huge tree, probably an oak, which must have been 4 or 5 feet in diameter at least. The canoe is 7 or 8 feet long, about 2 in breadth, and 2 in depth, with ends roughly and abruptly pointed. It is flat-bottomed, no doubt because the lake was shallow even in ancient times. Through one of the ends of the boat, which served as the stern, is a round hole, through which it is conjectured a pole was thrust, either to steer the boat by or paddle with. This hole was plugged up with a conical piece of wood. Not the least curious parts of the canoe are two wooden *wings*, 5 or 6 inches broad, which were fastened to the sides by round plugs of wood; perhaps they served to steady the boat. Two iron crooks, each about 18 inches long and fastened together by a ring of iron, were found near it, and look like a rude anchor. The whole thing looks as if it had been made with great care, but by a nation unacquainted with planes or sharp-

; instruments ; though that *some* uses of iron were known is shown anchor. The canoe is the property of W. Hartley, Esq., and it is o be hoped that some good antiquarian will give us a more accurate t of it and its different parts.

ᴀᴛᴀ.—The name of the writer was omitted in the letter, pp. 248, 249. by Dr. Leslie. At page 242, *for* tab. "xxxii." *read* tab. "xxxii*."

MISCELLANEOUS NOTICES.

'Quarterly Review' of last month (July) has an exhaustive article Tyndall's 'Glaciers of the Alps' (1860).

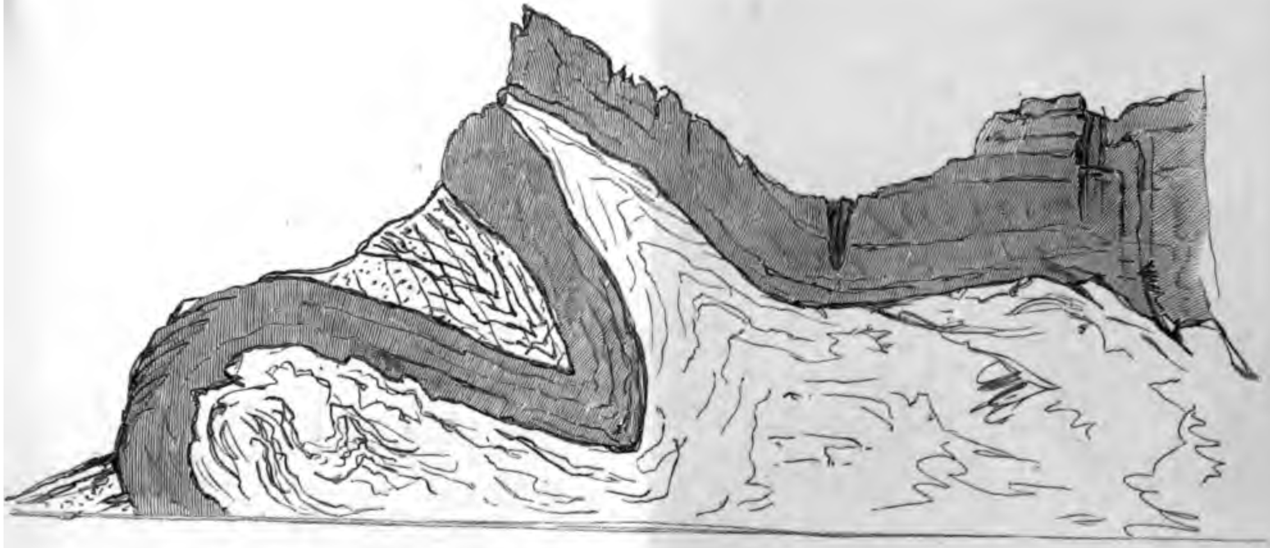
fifth part of vol. iv. of the 'Tyneside Naturalists' Field Club,' ıs the reports of the dredging expedition to the Dogger Bank and ;he coasts of Northumberland, made under a grant from the British ation in 1861. There is an article on the "Geological Features of ırish of Edmondbyers," by the Rev. W. Featherstonaugh, M.A. ›oint forms, for five miles, the north-west boundary of the county rham, and is mostly unenclosed moorland. The higher ranges of ırying from 1000 to 1300 feet above the level of the sea, are composed s of sandstone of various qualities, forming part of the "Millstone the strata of which dip towards the south-east, and overlie, in deng order, beds of ironstone, limestone, and the metalliferous strata, furnish the mineral wealth of the Derwent Heads and the Allenlead mines.

REVIEWS.

The Correlation of the Natural History Sciences. By D. T. Ansted, M.A., F.R.S.

his, the Rede lecture, delivered before the University of Cambridge 12th of May last, Professor Ansted points out some of the mutual ns that exist between the various departments of science, but espethe manner in which all natural sciences relate to geology, and y to all the others. By comparisons of this kind, he justly observes, tions are obtained leading to fresh discovery, while they give preto our knowledge, and serve not unfrequently to remind us of our nce. The lecture is clear and concise, and precisely displays how vance of one science forces on improvements and modifications in r, and that progress cannot be effected in any without its effects felt in all the rest, as well as amongst each other. A knowledge of rfect circulation of water, for example, is a definite result of modern gation, and is fruitful in geological suggestions. Present in the ocean, and covering a part of the land, the quantity of fluid water globe is manifestly limited, in great measure, by temperature. And question touches on Meteorology. Were the earth cooled down the freezing-point of water, though a certain portion of aqueous r would remain to form an atmosphere, the whole earth would be solid, e circulation of water checked. Were the temperature to be raised above the boiling-point, the water would exist only as a vapour-atmosphere. In this case also its circulation would be arrested, and life would cease. In this way the subject might be extended to zoology, and on through chemistry, physical geography, and the whole circle of the sciences. At present geologists are apt to assume the internal igneous fluidity of the earth, and much useless speculation has been indulged in as to the thickness of its crust. Calculating from established observations, Professor W. Thomson considers that the solid substance of the earth must consist, on the whole, of solid material, more rigid than steel, because if it were not so, the actual height of the tides and the amounts of precession and nutation would be smaller than they are found experimentally to be. But the rigidity of the upper or surface-crust of the earth is less rigid than glass, and therefore the interior must be more rigid than steel.—a fact utterly at variance, Professor Ansted admits, with the hypothesis of the earth being a mass of molten matter enclosed in a hollow shell less than a hundred miles thick, open to volcanos and disturbed by earthquakes, whilst he considers it agrees with the calculation formerly made by Mr. Hopkins, from other data, that the crust cannot be less than 800 miles thick. Professor Thomson, however, concludes that no thickness of crust, less than half the earth's radius, could enable our planet to preserve its figure with sufficient rigidity to allow the tidal phenomena and the phenomena of nutation and precession to be as they are.

Again, the observations recently made by Professor Tyndall on the effect of vapour on solar heat-rays reflected back from the earth into the air, though not having apparently much to do with the rigidity of the earth, and strongly contrasting in the nature of the method employed, point to the same general conclusion, and afford another example of the correlation and of the intimate dependence of different departments of inquiry. It results from Professor Tyndall's experiments, that of the heat radiating from the earth in England, more than ten per cent. is stopped within a distance of ten feet from the surface. In proportion as the air contains more vapour it radiates less rapidly, and it would seem to follow that a uniform steam-temperature of the earth's surface must so completely intercept the solar heat-rays as to render the earth unfit for any kind of life, animal or vegetable, with which we are acquainted. In other words, the balance of heat received from the sun must probably have existed at all times nearly as it does now, to allow of such organic life as we know of. A very much higher temperature, Professor Ansted thinks, would, by disturbing this equilibrium, unfit the earth for the existence of races so nearly resembling those now living upon it as are indicated by even the oldest fossil remains. Mr. Glaisher's balloon experiments confirm Professor Tyndall's deductions as to the state of the atmosphere in the higher regions, and so unexpectedly these two seemingly unconnected meteorological experiments come in as evidence. It is in this manner that Mr. Ansted brings forward the most interesting facts in the modern progress of the sciences, to show their relationships to geology and to one another, and the influence of the advance of geology upon them. Agreeably and logically framed, Mr. Ansted's discourse will afford half an hour's intellectual gratification of an instructive and highly suggestive character.



SECTION OF THE BREZON, IN THE ALPS OF SAVOY.

From a Diagram by John Ruskin, Esq., F.G.S.

S. J. Mackie del.

THE GEOLOGIST.

SEPTEMBER 1863.

MR. RUSKIN'S LECTURE ON THE SAVOY ALPS.

By the Editor.

'r Mr. Ruskin's admirable lecture on the Alps of Savoy, delivered t the Royal Institution, we have already given an abstract at p. 256. Ve recur again to that subject because there were two points so »rcibly and so well put by Mr. Ruskin, and so seemingly pregnant ith the germs of future progress to our science, as to merit the ›ecial attention of geologists. These were the inefficacy of ice to :oop out lake-basins, and the mighty wave-like action of force that 'umbles the gigantic rock-masses of our mountains almost into ave-like breakers ready to nod and fall. "Geology," well remarked [r. Ruskin in his opening words, "properly divides itself into two ranches,—the study, first, of the materials and chronology of depo-ts; and, secondly, of their present forms." The interest attaching › the relics of organic life, without doubt, has carried geologists vay from the study of external forms; and this almost exclusion of 'gard for structural phenomena is the more to be regretted that it the threshold of the grand field of record of ancient physical phe-›mena. The gigantic mountain-wave is not heaved up and rolled ıwards in a few moments, like the surging waves of the sea; the ırticles of rock-masses are not quickly moved about like the ater-atoms of the dancing ripples on our rivers, but slowly—owly indeed—are the almost immovably linked-together particles 'rced onwards by some ponderous pressure, some solemn but irre-stible force, due perhaps to the very strain of the earth's altering rotation or the leverage of its surface inequalities upon its central axis. Into these questions Mr. Ruskin did not enter; he found enough, and more than enough, to do in his first essay to get the answer out of the easiest riddle he could find. No one can look at a piece of marble and not see the records of particle-changes in solid rocks. The stratum of sea-mud, once without a flaw, has been hardened, dried, cracked into innumerable fragments, and these are now soldered together by crystalline spar. Well, indeed, did Mr. Ruskin select the beautiful marble as an example of particle-movements in rocks. Nor let it be thought that the crystallizing action is confined to the open cracks; it goes through the very body of the stone: marble, black, white, grey, or variegated, is crystalline throughout. The sea-mud, which it was originally, did not fall on the ocean-bottom in crystals, nor did it dry up, like the salt of the sea, in crystalline forms. But it consolidated into a hard amorphous rock, and then the crystalline forces moved particle after particle, and put it into regular form. "So that," said Mr. Ruskin, in his eloquent language, "through the whole body of the mountain there runs, from moment to moment, year to year, age to age, a power which, as it were, makes its flesh to creep; which draws it together into narrower limits, and in the drawing, in the very act, supplies to every fissure its film, and to every pore its crystal." And in this change the imaginative mind of Mr. Ruskin saw, perhaps with prophetic distinctness, how all terrestrial things were purifying themselves for some greater end, some more beautiful condition. "All is advance," he said, "from disorder to system, from infection to purity; nor can any of us know at what point this ascent will cease. We can already trace the transformation from a grey flaky dust, which a rain-shower washes into black pollution, to a rock whose substance is of crystal, and which is starred with nests of beryl and sapphire. But we do not know if that change is yet arrested, even in its apparently final results. We know in its earlier stages it is yet in progress; but have we in any case seen its end?"

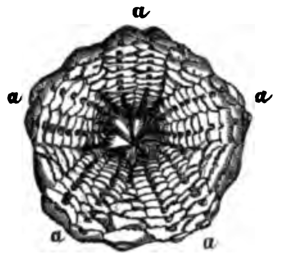
But not only is there a gathering together of circumambient particles round crystalline axes, but the very body of the rocks, over miles and miles of ground, are capable of onward surging motions, like the long rolling of heavy waves,—the very rocks that form those mountains which, to us, are the types of solidity and endurance. The "everlasting" mountains, as they seem to us, are to Mr. Ruskin's eye as viscous as the glacier ice; traversed by innumerable fissures permeating play and motion, sometimes filled with water, sometimes with vapour, with gelatinous flint, with metal-ore. We may have a crag-glacier, measurable in depth by miles instead of fathoms, stiffened with bands of agate and flexible with fibres of iron; *flexible, at all events, by its own molecular or fragmentary division*, and assuming new dimensions or flowing into new channels through gradations which are immeasurable, and in times of which human life—we might almost say human history—forms no appreciable unit. Having dealt with the substance of the mountain, Mr. Ruskin goes on to the formation. Taking its collective rock-strata as so many original sea-bottoms level and flat, he seeks to find out how the Alpine mountain assumed its present rugged, dislocated form. We do not say Alpine mountains, for such mighty monuments are not to be read at once; no eagle eye could read these wonders at a glance, with secrets hidden by fallen débris, and records buried and wrapped up in the folds and bends of a gigantic earth-mantle. Mr. Ruskin found a portion and a corner of the magnificent Alps of Savoy sufficient to task his skill and knowledge. "There are," said he, "the mountain which is cut by streams or by more violent forces out of a mass of elevated land, just as you cut a pattern in thick velvet or cloth; and there is the mountain produced by the wrinkling or folding of the land itself, as the more picturesque masses of drapery are produced by its folds. Be clear in separating these two conditions."

It is something wonderful to think of such slow but perfect plasticity in rock,—to see, in the mind's eye, particle pushing particle, and particle after particle yielding to the pressure through ages that man's race cannot count, lifting, rising, surging so slowly and solemnly, that no eye can perceive the motion, no ear detect the slightest grating in its onward rush; for rush it is, although so slow and silent. "There are," Mr. Ruskin continued, "two ways in which this folding of the hills may be effected. You may have folds suspended or folds compressed. If underneath, a mass comes up which sustains the folds,—a pendant wave; but if the force be lateral, you have a compressed wave. And observe this further distinction:—if a portion be raised by a force from beneath, unless the beds be as tenacious as they are ductile, they will be simply torn up and dragged out of shape at that place, and on each side the country will be undisturbed. But if they are pushed laterally into shape, the force of the thrust must be communicated through them to beds beyond; nay, the rock which immediately receives the shock may, if harder than those beyond it, show little alteration of form, but pass on the force to weaker beds at its side, and thus affect a much larger space of country than the elevatory convulsion. Now the fact is that in the Alps both these actions have taken place, and have taken place repeatedly, so that you have evidence both of enormous lateral thrusts which have affected the country for hundreds of miles, and of local elevations independently operating through them, and breaking their continuity of action. . . . The ripple of a streamlet rises, glances, sighs, and is gone. An Atlantic wave advances with the slow threatening of a cloud, and breaks with the prolonged murmur of its thunder. Imagine that substance to be not of water, but of ductile rock, and to nod towards its fall over a thousand vertical fathoms instead of one, and you will see that we cannot assert, perhaps cannot conceive, with what slowness of march or of decline the mountain-wave may rise or rest. But whatever the slowness of process, the analogy of action is the same. Only remember that this has taken place through rocks of every various degree of consistence and elasticity, and as the force thrills and swells from crag to crag, it is itself rent again and again into variously recoiling, quenched, or contracted energy, and divides against itself with destructive contradiction."

Two examples of this gigantic-wave action were taken by Mr. Ruskin for analysis,—Mont Brezon and Mont Saleve,—the former "notable in the clash and curve;" but as he knew it was full of almost incredible structures, he selected the latter to begin with as a most simple example, which had been already described by De Saussure, Studes, and Favre, from whose observations however Mr. Ruskin differs, and finds this simple mountain not so simple after all. These three geologists, leading or copying each other perhaps, as geologists very often do, represent the face of the hill towards Geneva to be formed by vertical beds; but Mr. Ruskin's impression is "that these perpendicular plates of crag, clear and conspicuous though they are, are entirely owing to cleavage,—that is to say, to the splitting of the rock in consequence of the pressure undergone in its elevation; and that the true beds curve into the body of the hill" (see Plate XVI.). "I dare not," he adds, "speak with any confidence in opposition to these great geologists, but I earnestly invite some renewed attention to the question, which is of no small importance in determining the nature of the shock which raised the walls of the Alp round the valley of Geneva." The ideal view of this mountain, which we give in Plate XVI., is from the diagram exhibited by Mr. Ruskin at the Royal Institution lecture, at which we were present, and from notes of which the present account of his views is given. It is but right to make this statement, as Mr. Ruskin is fully aware and feels the difficulties which at present attend the verification of these sections both of La Saleve and the Brezon. All the lower part of the Saleve is Jura limestone, as determined by Favre, and that this rises up in a nearly vertical sheet along the whole front, thrusting up the Neocomian and compressing it, Mr. Ruskin admits; "but there is doubt," he contends, "respecting these frontal clefts." Neither does he deny that there are raised beds of Neocomian on parts of the mountain, as assigned by Favre; but that at the Grande Gorge, where the natural section is clearest, there are the beds all following the curve of the summit, and that the vertical fissures are rather faults or cleavages, or partly both, the business being so complicated that one cannot tell which is which. Baffled by the simpler Saleve, Mr. Ruskin had little hope of resolving thoroughly the infinitely more complex Brezon; but on one or two points of it he gave very able expositions. And here again we take the liberty of copying another of his diagrams. "You see," he said in his lecture, "the group is composed of an isolated pyramidal mass, of a flat mass behind it" (see Plate XVII.), "which extends at both sides, and lastly, of a distant range of snowy summits, in which Mont Vergi and the Aiguille de Salouvre are conspicuous objects. Now these three masses are merely three parallel ridges of limestone-wave, formed mainly of originally horizontal beds of Rudisten kalk, approaching you as you stand looking from the Saleve. Probably, I think, approaching at this moment, driven towards you by the force of the central Alps, the highest ridge broken into jags as it advances, which form the separate summits of Alpine fury and foam; the intermediate one joining both with a long flat swing and trough of sea, and the last, the Brezon, literally and truly breaking over and throwing its summit forward as if to fall upon the shore. There is the section of it" (Plate XVII.); "the height from base to summit is 4000 English feet,—the main mass of the façade, formed of vast sheets of Rudisten kalk, 1000 feet thick, —plunging at last, as you see, in a rounded sweep to the plain." Nor is this instance an extraordinary one in anything but its simplicity and decision; the Brezon and Vergi group are only a portion of the longitudinal waves which flow parallel with the Alps through all their length, and which are cut across by transverse valleys, in which are the grandest scenes of Alpine precipice.

In treating of the sculpturing of mountains, or the working out of their actual forms, Mr. Ruskin laid the greatest stress on disintegration aided by chemical action, or by water acting as rain-torrent; and, although not ignoring the action of ice, dwelt properly and rightly on the view that ice was a less powerful agent than water in its other forms in a sculpturing capacity. In respect to the origin by glacier-excavation of the basins of the Swiss and other mountain-lakes, which Professor Ramsay claims to have suggested, we were very glad to hear Mr. Ruskin speaking out forcibly and to such good purpose. And it would be well indeed if, on some other so-called accepted topics, we had other keen thinkers speaking out as boldly and as eloquently as Mr. Ruskin has done on this.

After dwelling on the viscosity of glacier-ice, as shown by Forbes and admitted by Hopkins, Tyndall, and others, and generally everywhere now, and on those experiments which have shown the central portions of the glacier to be in quicker motion than the sides, which cling to the mountain or gorge on either hand, Mr. Ruskin charged the glacier motion as being wholly powerless wherever the glacier falls into a pit. "There have been," said he, "suggestions made that the glaciers of the Alps may have scooped out the lake of Geneva. You might as well think they had scooped out the sea. Once let a glacier meet with a hollow and it sinks into it, and becomes practically stagnant there, and can no more deepen or modify its receptacle than a custard can a pie-dish." And then he went on to show, as an example, how the great glacier of the Rhone could not cut a passage through the gorge of St. Maurice. That is indeed the true way to test: take a small obstruction, and see how a big glacier can deal with it. If it fail to remove *it*, how can it remove greater obstacles under less advantageous conditions, which it would have to do in scooping a lake-basin? Moreover, as Mr. Ruskin well put the facts forward, the glacier carries the fallen stones constituting its moraine on its surface, but does not produce the moraine by its own action. The glacier likes, so to speak, nothing under it; it glides forward on a launching smooth sheet; the moraine consists of the sheddings of the rocks above, not of the broken fragments of the ground beneath. The glacier, too, moves slowly; the torrent quickly, pushing stones, sand, and grit in its furious course, and grinding like a rough file moved at the rate of ten miles an hour. "The torrent cuts," says Mr. Ruskin, "the glacier cleanses; one is for incision, the other for ablution and removal; and so far as the present



ECHINOTHURIA FLORIS (New Species).

From the Chalk of Kent.

F.G.S., del.

ı concerned, you may ignore the glacier altogether. It only he torrent here and there by exposing a surface and by carry- the rubbish which the working water throws down; but the ılptors are natural disintegration and the stream, and every ʒ form in the Alps is distinctly traceable to one or other of orces combined with the internal geological structure."

ᶜCHINOTHURIA FLORIS, A NEW AND ANOMA- ᶠS ECHINODERM FROM THE CHALK OF KENT.

By S. P. Woodward, F.G.S.

fossils represented in the accompanying Plate are probably only nts of the original structure, and possibly only the smaller and less d portions of the whole. Nevertheless I have determined to pub- ıe account of them, although at the risk of committing an extrava- ror, as a last resort towards obtaining more complete examples or ions for their more correct interpretation.

specimens have been presented to the British Museum; one by J. ım Flower, Esq., of Park Hill, Croydon, the other by the Rev. n Glass, of London.

first example (Fig. A) was obtained, at least sixteen years ago, from ɔer Chalk of Higham, near Rochester, and was submitted to Prof. E. in whose custody it remained for several years. It was originally :o me in connection with the anomalous Cirripede *Loricula*, then liscovered by Mr. Wetherell. The resemblance between them is y curious; but there is no real relationship. Mr. Flower's fossil ex- .istinct traces of the crystalline structure peculiar to the petrified lermata, and the pairs of pores in the ambulacral plates are equally eristic of the Echinidæ. Mr. Darwin also has examined this fossil ected it from his province of inquiry.

Forbes could not make up his mind to describe the specimen, and ely it was returned to Mr. Flower, with whom it remained until lication of a note on the genus *Proto-echinus*, by Major Thomas in the 'Geologist' for 1860 (Vol. III. p. 446), when it was entrusted ɔr the purpose of considering whether it had any special affinity is new type, and for description in the same journal.

Proto-echinus was obtained from the Carboniferous limestone of lead, Wexford, and is but a fragment of a single ambulacrum, con- of three series of plates at the wider end and two at the other ex- , with apparently a single terminal plate. Each plate is perforated .ir of pores. It differs from Echinothuria in every particular.

The question presented to me by Mr. Flower's fossil was, whether to consider it part of the envelope of a new kind of Holothuria or whether it might be no more than a fragment of the oral disk of some great unknown Echinus. Portions of the imbricating scaly armour of a Psolus had been met with when examining the fossils of the boulder clay collected by Mr. J. Richmond, of Rothsay; but in Psolus, while the greater part of the body is clothed with fish-like scales, the ambulacra are only developed on one side, forming a creeping disk, the scales of which are small and not imbricated. On the other hand, the peristome of the largest known Echinite from the Chalk is less than an inch in diameter; and the largest recent sea-urchin in the museum has an oral disk not more than 2 inches wide, whereas the fossil is a segment of a disk which must have been at least 4 inches across. This objection, on the score of size, was however less felt, because the Cyphosomas and Diademas of the Chalk have larger oral and apical orifices than any other urchins, and the character of their apical disk was unknown, being only preserved in a few minute specimens of *C. difficile*, from Chute Farm. Moreover, there were indications in the Upper Chalk of a great Diadema, of which nothing more had been obtained than scattered plates and fragments of spines. This species is referred to in Decade V. of the Geological Survey (Article Diadema, Section C, spines tubular, annulated). Mr. Wetherell obtained a mass of chalk containing above one hundred fragments of spines, which are hollow, striated and annulated, as in the recent *D. calamaria*. From the plates mingled with the spines we ascertained that the ambulacral pores presented the usual characters, being arranged in single file, and a little crowded near the peristome; but many of the plates presented only their smooth inner surfaces. A smaller mass of chalk, in Mr. Wiltshire's cabinet, contains similar plates and spines, mingled with a few true scales and minute truncated spines like those of Echinothuria. The Diadema spines were erroneously referred by Prof. E. Forbes to the genus Micraster (decade iii. pl. 10, fig. 15; bad, for they are not spiral). They are also figured by Dixon, in his 'Geology of Sussex,' and described by Forbes as "spines of a Cidaris." Diademas possessing spines of this character are known to occur in the Upper Cretaceous strata of France; and Dr. Wright has lately obtained a small specimen from the chloritic marls of Dorsetshire. In these the apical disk is quite small.

A more serious difficulty, in comparing Mr. Flower's fossil with the oral disk of any Echinite, was presented by the arrangement of the plates; in the recent Echinidæ (like the Cidaris represented by Fig. E) they are all directed towards the dental orifice, but here the alternate series take opposite "dips," the ambulacral plates overlapping one way and the others in a contrary direction.

Last year, while I was still hesitating about the publication of Mr. Flower's fossil, a second specimen was obtained from Charlton, in Kent, by the Rev. N. Glass, who has cleared it from the matrix with great skill and patience. It is represented by the figure marked D, and contains the dental apparatus, or "lantern," and portions of several series of imbricating plates radiating from it. At first sight, this specimen would seem to solve the problem, by supplying the peristome and lantern of the same great Cyphosoma or Diadema, of which Mr. Flower's specimen might be the apex or periproct. But a closer examination confirms the objections already stated, and gives increasing probability to the other conjecture (if, indeed, it does not compel us to adopt it), however difficult it may be to realize the notion of an Echinite having no proper "test," and clothed entirely with imbricating scales like those of the peristome of Cidaris.

In Mr. Flower's specimen (A) the imperforate plates imbricate towards the centre (or apex, *a*), where the smaller ends of the several series converge. In Mr. Glass's specimen they slope away from the centre (or mouth), that is, also towards the apex. The perforated or ambulacral plates, which overlap one another outwardly (*i. e.* downwards) in specimen A, are seen in B sloping towards the dental cone, and reclining upon it. The portion of an ambulacrum situated between the letters *a*, *b*, *c* (in B), consists of seven plates, diminishing in size from *c* to *a*, in a line not accurately directed towards the centre. This portion exhibits the *interior* surface of the plates, known by their curved surfaces, destitute of ornamental granules; it is not, however, the oral end of one of the segments turned over, a thing scarcely possible to happen, for in that case the dip of the plates would be reversed, but it must be the opposite (or apical) extremity of a series folded back upon its origin, and exposed to view by the damage which the surface of the specimen has sustained. From this circumstance it seems probable that the whole fossil, when complete, was not elongated nor even spherical, but somewhat depressed in a vertical direction, though doubtless admitting of a moderate amount of flexure. At the last hour, after making the drawing, I ventured to clear away the chalk from the side of Mr. Glass's fossil (near the letter *i*), where an ambulacral segment is seen to curve as if it might be continued round to the other surface. This attempt was successful, for the ambulacrum and also the adjacent interambulacral segment (*h*) were found continuous, though crowded and displaced at the turning, falling again into regular order, and diminishing in size, though not so nearly complete as in Mr. Flower's example.

After this apparently conclusive demonstration, it appears desirable to give a name to the fossil, and to attempt a short description, although its rank and affinities are to us still matter of conjecture. At present it is one of those anomalous organizations which Milne-Edwards compares to solitary stars, belonging to no constellation in particular. The disciples of Von Baer may regard it as a "generalized form" of Echinoderm, coming, however, rather late in the geological day. The publication of it should be acceptable to those who base their hopes on the "imperfection of the geological record," as it seems to indicate the former existence of a family or tribe of creatures whose full history must ever remain unknown.

Order *Echinida*. Genus *Echinothuria*.*

E. floris, n. sp.; *test* globular?, diameter of compressed specimen 4 inches, thickness ½ an inch, lantern projecting ½ an inch; composed of ten segments or double series of imbricating plates, ornamented with obscure miliary granules and small spine-bearing tubercles, a few larger than the rest; *interambulacral* plates narrow, slightly curved, with the convex edge upwards and overlapping; the alternate plates bearing one large extero-lateral tubercle, perforated, and surrounded by a raised ring and smooth areola; largest plates measuring 6 lines in length, the smallest 3 lines or less (the longest in second specimen equalling 7 lines); *ambulacral* plates 7 lines long, equalling the breadth of the exposed portion of eight plates, similar to the former, but curving and imbricating downwards towards the dental orifice, and having two small plates, each perforated by a pair of pores, intercalated in a notch of the middle of the lower margin; a third pair of pores perforating the plate itself a little external to the centre; primary tubercles few, irregularly distributed.

Spines of three kinds; those adhering to the plates minute and striated; fragments of larger spines (not certainly belonging to the species), striated, annulated, and furnished with a prominent collar to the articular end (Fig. C); the third kind minute, clavate and truncate, articulated (?) to a slender stalk (Fig. E *d*).

EXPLANATION OF PLATE.

Fig. A. Mr. Flower's fossil; *a*, centre of upper surface; *b*, an interambulacral segment; *c*, ambulacrum; *d*, lateral half of a second interambulacrum.

Fig. B. Mr. Glass's specimen; *o*, dental apparatus; *a*, inner surface of apical portion of an ambulacrum; *c*, *e*, *g*, *i*, *l*, position of the five ambulacral segments; *b*, *d*, *f*, *h*, *k*, position of five interambulacral segments, of which only fragments remain; *d*, *k*, position of small clavate spines.

Fig. C. Three ambulacral plates near the summit, showing to what extent their outer ends are overlapped by the interambulacral plates.

Fig. D. One of the larger spine-fragments, natural size and magnified.

Fig. E. Oral disk and teeth of a recent Cidaris; *a*, the five ambulacral segments with notched and perforated plates.

CORRESPONDENCE.

Foraminifera of the Chalk.

SIR,—I was much pleased, in looking over your "Thoughts on Dover Cliffs," by meeting with the Foraminifera figured in Plate I. representing so many forms; also with the notes of the figured specimens by Professor

* Etymologists need not trouble themselves about the derivation of this name; it is intended merely to express the dilemma in the writer's mind, arising from imperfect knowledge, but which he believes to have no foundation in nature.

ıpert Jones, F.G.S., obligingly given you. I ask, would you have the ıdness to give me a simple method of treating chalk so as to procure ›se microscopic creatures, whose carcases build up so many thousand les of solid chalk rock? Yours truly,

R. M. F.

[To prepare chalk for microscopic examination, if only small quantities are to be treated, best plan is to select a piece of soft white chalk,—that which has been kept some time ı cabinet is most easily worked,—especially chalk from the interior of an Ananchyte Galerite, and to wash it with a moderately soft nail-brush in a hand-basin half full of er, keeping the chalk and brush under the surface, so that the loosened particles uld all fall in the water. To prevent the chalk from being worn into longitudinal rows, the part under the brush should be constantly moved round. It should also looked at occasionally, with a hand magnifier, so that any large specimens of Bryozoa l Foraminifera may not be destroyed by rough brushing, but be more carefully picked with a needle or penknife, or separated by the careful use of the brush. When a ficient quantity has been brushed down, the water should be stirred and the chalky tion poured away, or water should be allowed to run into and overflow the basin, .il the water remains clear over the sediment. The latter should then be placed in a ınd-bottomed cup or gallipot, and rubbed gently with the finger in water, until, by ther washing, some more of the chalk has been removed, when the residue should b: efully dried in an oven or otherwise, without the least disturbance. When dry, it ıy be sifted and picked, but if it be still "chalky," further manipulation by gentle ›bing in water will be necessary, especially if the chalk-dust has been put by for some ıe after having been prepared. On a large scale, chalk may be prepared by being oken up in a mortar, or roughly ground with a brick, stone, or roller, on a pavement, d then freely washed in water, the large fragments being excepted.

The above, and other instructions for "the preparation of clays, sands, and chalk for icroscopic purposes," were given in the first volume of the 'Geologist,' 1858, p. 248, Mr. Rupert Jones; and in the same paper, a sieve, with a double cylinder, and fitted th different zinc perforated plates, was described and figured. Such sieves can be had Mr. Snow, zinc-worker, 50, Millbank Street, Westminster, at the cost of about 3*s*.]

NOTES AND QUERIES.

Discovery of another Cave at Uphill.—Sir,—It may be interestıg to your readers to learn that another cave has lately been opened at 'phill. Its entrance is on the south side of the rock, at an elevation of bout sixty feet from the base. Besides the usual stalagmitic breccia, ommon to the caves of the Mendips, this is partially filled with an unctuous ›am, which is exceedingly rich in animal remains. I have obtained bones f the wolf, fox, wild-boar, otter, and also the horns of a stag; and, which dds not a little to the interest of the discovery, several human remains ssociated with them—amongst others, a thigh bone, part of a frontal one, and portions of the upper jaw with the teeth *in situ*, of a human dult. I have been informed several crania have been exhumed, but in onsequence of there being no local museum in which to deposit them, hey have been removed to Oxford. As yet no trace of any extinct animal ıas been met with; but should such hereafter be found, the problem of he antiquity of man will meet an unexpected solution. I believe the nerit of the discovery of this cave is due to Mr. Parker, of Oxford, at whose expense the workmen are employed in exploring it.

I remain, Sir, your obedient servant,

Charles Pooley.

Weston-super-Mare, August 25, 1863.

A CLASSIFIED AND STRATIGRAPHICAL LIST OF FOSSIL MAMMALIA. By S. J. Mackie, F.G.S.

+ European area. † N. American. o S. American. * African. ‡ Asiatic. § Australasian.

Species.	Alluvial.	Diluvial.	Caverns.	Pleistocene.	Pliocene.	Miocene.	Eocene.	Cretaceous.	Oolitic.	Localities, Authorities, and References.
I. CARNIVORA.										
1. Ursidæ.										
Ursus sp.			×							*Caverns*, Krapacks mountains (= Dragons fossiles), J. P. Hayn, Eph. Nat. Cur. Déc. 1, 1672; Ann. iii. p. 220, Obs. 139, p. 257, and Obs. 194, p. 166.
——			?							—— ? (= Licornes fossiles, and Os de dragons), Transylvania, Wolgnad, *op. cit.* 1673, p. 214.
——			×							*Caverns*, Hungary, Brückmann (= bones of bears) (1732), Descrip. des Cavernes de Hongrie, Coll. de Breslau, 1r tom. p. 628; and Sammlung von Nat. et Med. Acad. Nat. Cur. in Breslau (1725), s. 509, Relat. xv. xxiv. s. 628.
——			×							*Caverns*, Camper, Matér. pour l'Histoire et la Conn. des Foss. 1795, 1r cahier.
——			×							*Caverns*, Rosenmüller, Abbildungen und Besch. der fossilen Knochen der Höhlen-Baeren, 1804.
—— (9 species ?)			×							*Caverns*, Franconia, Esper (1774), Descrip. des Zoolithes, tab. i. to xiv. (Gailenreuth and Bayreuth.)
——										Blumenbach.
——										Cuvier.
——										Wagner.
—— ?										*Pleistocene*, gravel and marl, Folkestone, Mackie, the specimen in Folkestone Museum.
—— ?						?				*Miocene*; (?) Sansan, Archiv für Naturgeschichte, 1843, t. 1, p. 24. Pictet, p. 186.
—— spelæus		×	×							*Caverns*, England, France, Belgium, Germany, etc. = Ours des Cavernes, and Ours à front bombé, Cuvier, Ossem. Foss., 4th edit. t. vii. pp. 248 and 252; = *Ursus spelæus*, Blumenbach; Schmerling, Ossem. Foss. des Cavernes de Liége; De Blainville, Ostéographie, p. 53; Wagner, Archiv für Naturgeschichte; Owen, Brit. Foss. Mammal. p. 86; Giebel, Fauna der Vorwelt, t. i. p. 67; Gervais, Zool. et Pal. Fr. p. 105; Juliet, Comptes Rendus de l'Acad. des Sc. (Sept.) 1835; Hörnes, Cavernes de Brünn (Wiener Mitth. 1848, t. iv. p. 176); Giebel, Caverne de Sundwich (in Leonh. and Bronn's Neues Jahrbuch, 1849, p. 61); *Loess*, Odessa, Nordmann, Ossem. Foss. trouvés à Odessa, p. 4; *Loess*, Brisgau, Gegenbach, Verh. Basel Nat. Gesellsch., 1838–40, p. 81; *Cavern*, Gaylenreuth; Pictet, Paléontologie, p. 187; Atlas, pl. 2, f. 1–3; (= *Ursus arctoideus*, Blum. = *Ursus planus*, Oken, = Ours à crâne moins bombé, Cuvier, = females of *U. spelæus*, Blainville;) Pictet, Paléont. p. 188; *Cavern* of Baumann and Scharz-

										Sc. Nat. et de Géologie (Jan.), 1830, p. 311; Pictet, Paléontologie, p. 188; Blainville, Ostéog. p. 65.
—— spelæus, *var.* metopoleianus	...	...	...	...	...	...	...	...	...	—— ?, —— ?, Marcel de Serres, Annales des Sc. d'Observation (Feb.) 1830, p. 229; Pictet, Paléont. p. 88.
—— spelæus, *var.* metoposcairnus	...	...	...	...	...	...	...	...	...	—— ?, —— ?, Marcel de Serres, *op. cit.* p. 229; Pictet, Paléont. p. 198.
—— spelæus =planus	...	...	×	...	...	...	...	...	...	*Caverns*, *loc. cit.* Oken.
—— spelæus =spel. *fem.*	...	...	×	...	...	...	...	...	...	*Caverns*, *loc. cit.* Blainville.
—— spelæus, *var.* Neschersensis	...	...	?	...	...	...	...	...	...	—— ?, Neschers, near Clermont-Ferrand, Croizet and Jobert, Recher. sur les Oss. Foss. du Puy-de-Dôme ?; Blainville, Ostéog. p. 69.
—— spelæus, *var.* dentifricius	...	...	?	...	...	...	...	...	...	—— ?, H. v. Meyer, in Leonh. and Bronn, Neues Jahrb. 1839, p. 78.
—— spelæus, *var.* fornicatus (major and minor)	...	...	×	...	...	...	...	...	...	*Caverns*, Liége, Schmerling, Ossem. Foss. des Cavernes de Liége, p. 105.
—— spelæus, *var.* giganteus	...	...	×	...	...	...	...	...	...	*Caverns*, Liége, Schmerling, *op. cit.* p. 113.
—— priscus (= Ursus arctos)	×	×	×	...	...	...	...	...	...	*Caverns*, Gaylenreuth, Goldfuss, Nova Act. Acad. Nat. Cur. t. x. 2, p. 259; Cuvier, Ossem. Foss. 4th edit. t. vii. p. 265; Liége, Schmerling, *op. cit.* p. 87; Kent's Hole, Torquay, Owen, Brit. Foss. Mam. p. 82; S. of France, Gervais, Zool. et Pal. Franç. p. 107; Pictet, Paléont. p. 189; Atlas, pl. 2, f. 4–6. Owen, etc.
—— arctoideus	...	...	×	...	...	...	...	...	...	*Caverns*, England, France, Belgium, Germany, etc., Blumenbach; Cuvier, Ossem. Foss. 4th edit. t. vii. p. 162.
—— arctoideus, *var.* Leodiensis	...	...	×	...	...	...	...	...	...	*Caverns*, Liége, Schmerling, *op. cit.* p. 106; Pictet, Paléont. p. 188.
—— Arvernensis	...	...	...	...	×	...	...	...	...	*Pliocene*, Montagne de Perrier, Croizet and Jobert, Recher. sur les Oss. Foss. du Puy-de-Dôme, vol. i. p. 188, pl. 3, fig. 4.
—— Arv. (= *U. minimus*)	...	...	...	?	...	...	...	...	...	*Pleistocene ?*, Montagne de Boulade, Devèze and Bouillet, (= alluvial) Mont. de Boulade, p. 75, pl. 13, fig. 1, 2; Blainville, Ostéographie, p. 63; Giebel, Fauna der Vorwelt.
—— minutus	...	...	...	...	×	...	...	...	...	*Pliocene*, Marine sands of Montpellier, Gervais, Zool. et Pal. Fr. p. 107, pl. 8.
—— sp.	...	...	...	...	?	...	...	...	...	*Pliocene ?*, Boutonnet, Montpellier, De Luc (1772); Gervais, Zool. et Pal. Fr. p. 107, pl. 8, fig. 1.
—— cultridens (= *U. Etruscus*, Cuv.	...	...	...	...	...	...	...	...	...	See *Machairodus*.
—— sp.	...	...	...	...	...	...	...	...	...	*Diluvium*, Manea Marsh, Cambridgeshire, Owen, *op. cit.* p. 77.

× European area. † N. American. o S. American. * African. ‡ Asiatic. § Australasian.

Species.	Alluvial.	Diluvial.	Caverns.	Pleistocene.	Pliocene.	Miocene.	Eocene.	Cretaceous.	Oolitic.	Localities, Authorities, and References.
Ursus sp.		×								*Diluvium*, Hamburg, Zimmermann, in Leonh. and Bronn's Neues Jahrb. 1845, p. 73.
—— sp.		*								*Diluvial ?*, Osseous Breccia, Oran, Algeria, Milne-Edwards, in Ann. des Sc. Nat. ser. 2, t. vii. p. 216
—— Americanus		†								*Cavern*, Big Bone Cavern, United States of America (with bones of *Megalonyx*), Harland, Medic. and Phys. Researches, p. 329.
—— Brasiliensis										Lund. See *Nasua ursula*.
—— Sivalensis										Cautley and Falconer. See *Hyænarctos*.
Hyænarctos Sivalensis						‡				*Tertiary*, Siwalik hills, Cautley and Falconer, Asiatic Researches, t. xix. p. 1; Ann. des Sc. Nat. ser. 2, t. ix. p. 128, and (= *Ursus Sivalensis*,) Ann. des Sc. Nat. ser. 2, t. vii. p. 60; (= *Agriotherium*,) Wagner, Münch. Gelehrte Anz. 1837, t. v. p. 335; (= *Sivalours*, *Sivalarctos*, and *Amphiarctos*,) Blainville, Ostéographie, p. 68, and pp. 96 and 114; Owen, Odontography, 1845, p. 504, pl. 131; Pictet, Traité de Paléontologie, p. 189, pl. 11, fig. 7 and 8 (=*Amyxodon*, Fred. Cuvier).
Procyon priscus		*								*Diluvium ?*, Fissure in rock, filled with hardened clay and sand, Illinois, Leconte, Silliman's Journal, 1848, t. v. p. 102.
Nasua ursina			o							*Caverns*, Brazil, Lund, Oversigt Danske Forh. 1842; (= *Ursus Brasiliensis*,) Mém. de l'Acad. de Copenhague, t. ix. p. 198; Ann. Sc. Nat. ser. 2, t. xi. p. 224.
—— sp.			o							*Caverns*, Brazil, Lund, Mém. de l'Acad. de Copenhague, t. ix. p. 198; Ann. Sc. Nat. ser. 2, t xi. p. 225.
—— ? sp.							×			*Suessonian*, Tertiary clay, Meudon, Blainville, Ostéographie—*Subursus*, p. 72.
Meles taxus (seu vulgaris)										*Caverns*, England, Belgium, France, Germany, Auct.; (=*M. antediluvianus*), Schmerling, Ossem. Foss. des Cavernes de Liége, t. i. p. 159; (= *M. antiquus*,) Munster, Bayreuth Petref. p. 87; (= *M. vulgaris fossilis*,) H. v. Meyer, Palæologica, p. 47: see also M. de Serres, Dubreuil, and Jean-Jean, Ossem. Fluviatiles de Lunel-Viel; Desnoyers, Comptes Rendus de l'Acad. des Sc. 1842, ser. 1, p. 522; Gervais, Zool. et Pal. Fr. p. 117; Billaudel, Soc. Linn. de Bordeaux; [illegible] Odessa, p. 4; Giebel,

										pl. 3, fig. 1–3.
Amphicyon giganteus						×				*Miocene*, Terrains Tertiaires, Sansan, LARTET, Notice sur la Colline de Sansan, p. 16, and Ann. des Sc. Nat. t. vii. p. 119; PICTET, Paléontologie, vol. i. p. 194; Atlas, pl. 4, fig. 4–7; BLAINVILLE, Ostéographie, "Petits Ours," p. 78; (= *Amph. giganteus*,) LAURILLARD, in D'Orbigny's Dict. Univ. d'Hist. Nat. t. iii. p. 567; (= Chien d'une taille gigantesque,) CUVIER, Ossem. Foss. 4th edit. t. vii. p. 481, pl. 193, fig. 20, 21; *Miocene*, Chevilly (Loiret), Avaray (Loire-et-Cher); Sansan, (= *A. major*,) BLAINVILLE, Ostéographie, p. 113; PICTET, Paléontologie, p. 195.
—— major						×				*Miocene*, Sansan; GERVAIS, Zool. et Pal. Fr. p. 112; LARTET, Notice sur la Colline de Sansan, p. 16, et Ann. Sc. Nat. vii. p. 119; PICTET, Paléont. p. 195, pl. 3, fig. 1–7.
—— minor?						?				*Miocene*, Sansan, BLAINVILLE, Ostéog. "Subursus," p. 114; LARTET, Notice sur la Colline de Sansan, p. 19; GERVAIS, Zool. et Pal. Fr. p. 215; PICTET, Paléontologie, p. 195.
—— Blainvillii						×				*Miocene*, Digoin, Auvergne, GERVAIS, Zool. et Pal. Fr. p. 112 (? = *A lemanensis*, POMEL); PICTET, Paléontologie, vol. i. p. 195; POMEL, Bull. Soc. Géol. de Fr. 2 ser. t. iv. p. 379.
—— gracilis						×				*Miocene*, Auvergne, POMEL, Bull. Soc. Géol. ser. 2 (1846), t. iv. p. 379; (= *A. elaverensis* of GERVAIS, and jaw of *Canis Issiodorensis* of BLAINVILLE,) POMEL; (with doubt) GERVAIS, Zool. et Pal. Fr., explic. de la pl. 28, and pl. 112; (= *Cynelos*,) St. Gérand-le-Puy; JOURDAN, in Musée Saint-Pierre à Lyon; *Miocene*, Auvergne, St. Gérand-le-Puy, (? = *Amphicyon*,) PICTET, Paléont. t. i. p. 195.
—— brevirostris						×				*Miocene?* Auvergne?, CROIZET, Bull. Soc. Géol. t. iv. p. 25; (= *Amphicyon*,) GERVAIS, Zool. et Pal. Fr. p. 116; BLAINVILLE, Ostéographie, "Chiens," p. 122; POMEL, Bull. Soc. Géol. ser. 2, t. iii. p. 366; Calcaire lacustre de Georgovia, near Clermont, Puy-de-Dôme; GERVAIS, Zool. et Pal. p. 111.
—— dominans						×				*Miocene*, Germany, H. v. MEYER, in Leonh. and Broun's Neues Jahrb. 1843, p. 388.
—— Klipsteinii						×				*Miocene*, Germany, H. v. MEYER, *op. cit.* 1843, p. 388.
—— intermedius							×			*Eocene*, H. v. MEYER, ——?
—— Eseri							×			*Eocene*, Ulm, PLEININGER, Leonh. and Bronn's Neues Jahrb. 1851, p. 512.
—— antiquus						×				*Miocene?*, Eppelsheim (= *Agnotherium*), KAUP, Ossem. Foss. du Mus. de Darmstadt, livr. ii. p. 28, pl. 1, fig. 3, 4; BLAINVILLE, Ostéog. "Subursus," p. 79; GERVAIS, Zool. et Pal. Fr. p. 18, descr. of pls.; PICTET, Paléont. vol. i. p. 195.
—— diaphorus						×				*Miocene?* Eppelsheim (= *Gulo*), KAUP, Karstens Archiv, t. v. p. 151; Ossem. Foss. de Darmstadt. t. ii. p. 15 (= ? *Amphicyon*); PICTET, Paléontologie, p. 195.
Pseudocyon Sansaniensis						×				*Miocene*, Sansan, LARTET, Notice sur la Colline de Sansan, p. 16.
Hemicyon Sansaniensis						×				*Miocene*, Sansan, LARTET, Notice sur la Colline de Sansan, p. 16; GERVAIS, Zool. et Pal. Fr., exp. pl. 28.

× European area. † N. American. o S. American. * African. ‡ Asiatic. § Australasian.

Species.	Alluvial.	Diluvial.	Caverns.	Pleistocene.	Pliocene.	Miocene.	Eocene.	Cretaceous.	Oolitic.	Localities, Authorities, and References.
Hyænodon	...	...	...	...	...	×	...	...	...	*Miocene?* Cournon, Puy-de-Dôme, Laizer and Parieu, Comptes Rendus de l'Acad. des Sc. 1838, sem. 2, p. 442; Ann. des Sc. Nat. ser. 2, t. xi. p. 27; Blainville, Comptes Rendus de l'Acad. des Sc. 1838, sem. 2, p. 1004; Pictet, Paléontologie, p. 196, pl. iii. f. 9.
——	...	...	...	...	...	...	?	...	...	*Eocene?*, Paris, Dujardin, Comptes Rendus, 1840, sem. 1, p. 134; Blainville, Ostéographie, "Petits Ours," p. 55; Pomel, (*Pterodon*,) Bull. Soc. Géol. de Fr. ser. 2, t. i. p. 591; t. iv. p. 385; Cuvier, (*Taxotherium*, *Pterodon*,) Ossem. Foss. 4th edit. t. v. p. 490; Gervais, Zool. et Pal. Fr. p. 128, pl. 26.
—— dasyuroides	...	...	...	...	...	...	×	...	...	*Parisien supérieur*, Plâtrières of Paris; (= *Thylacine* des Plâtrières,) Cuvier, Oss. Foss. ?(= *Pterodon dasyuroides*,) Gervais, Zool. et Pal. Fr. p. 130; (= *Pterodon dasyuroides*,) Blainville, Ann. Fr. et Étran. d'Anatomie et de Physiologie, 1839, t. iii. p. 23; (= *Pterodon Parisiensis*,) Blainville, Ostéographie, "Subursus," p. 48, pl. 12.
—— Cuvieri	...	...	...	...	...	...	×	...	...	*Eocene*, Plâtrières de Paris; (= *H. Parisiensis* of some authors;) Pomel, Bull. Soc. Géol. Fr., 2 ser. t. iv. p. 392; Gervais, Zool. et Pal. Fr. p. 129, and pl. 11, 12, 15, 25; (= Carnassier voisin des Coatés et des Ratous,) Cuvier, Oss. Foss. t. iii. p. 269, pl. 69, f. 2–4; (= *Nasua Parisiensis*,) H. v. Meyer, Palæont. p. 47; (= *Taxotherium Parisiense*,) Blainville, Ostéographie, "Subursus," p. 55; (= *Hyænodon Parisiensis*,) Laurillard, in D'Orbigny's Dict. de Nat. Hist. t. iv. p. 768; Atlas, pl. 7, fig. 10, 11; (= *Taxoxylum Nicensis*, of Keferstein, Naturg. t. ii. p. 201, *vide* H. v. Meyer, in Bronn's Index Palæontol.); Pictet, Paléont. i. p. 200, pl. 3, fig. 12–12.
—— Requieni	...	...	...	...	...	...	×	...	...	*Eocene*, Dépôts Éocènes supérieures, Debruge, Apt, and Alais, Gervais, Comptes Rendus de l'Acad. des Sc. 1846, t. xxvi. p. 491; Ann. des Sc. Nat. ser. 3, t. v. p. 257; Zool. et Pal. Fr. p. 129, and pl. 11, 12, 15, 25.
—— minor	...	...	...	...	...	...	×	...	...	*Eocene*, Dépôt Éocène Tertiaire, Alais, Gervais, Zool. et Pal. Fr. p. 129, pl. 25.
—— leptorhynchus	...	...	...	...	...	×	...	...	...	*Miocene*, Terrains Tertiaires, Miocènes inférieures, Laizer and Parieu, Comptes Rendus de l'Acad. des Sc. 1838, sem. 2, p. 442; Ann. des Sc. Nat. ser. 2, t. xi. p. 27; Blainville, Ostéographie, [illegible] Buckland, Bridgewater

										...in D'Orbigny's Dict. de Nat. Hist. t. vii. p. 667 ; Pomel, Bull. Soc. Géol. t. iv. p. 382 ; Pictet, Paléontologie, p. 200 ; Atlas, pl. 3, fig. 8.
Acanthodon ferox						×				—— ?, Terrains Tertiaires de Weisenau, H. v. Meyer, in Leonh. and Bronn's Neues Jahrb. 1843, p. 702 ; Pictet, Paléontologie, vol. i. p. 201.
Harpagodon maximus						×				—— ?, Bohnerz d'Alstadt, près de Mœszkirch, H. v. Meyer, in Leonh. and Bronn's Neues Jahrb. 1837, p. 675, 1838, p. 413 ; Pictet, Paléontologie, vol. i. p. 201.
Canis Parisiensis							×			*Eocene*, Plâtrières de Montmartre, Cuvier, Ossem. Foss. 4th edit. t. v. p. 486 ; Laurillard, Dict. Hist. Nat. t. iii. p. 570 ; Blainville, (= *C. lagopus fossilis*,) Ostéographie, "Chiens," p. 107, pl. 13 ; Pictet, Paléontologie, p. 202 ; Gervais, Pal. et Zool. p. 111.
—— gypsorum ?							×			*Eocene*, Plâtrières de Montmartre, Cuvier, Ossem. Foss. 4th edit. t. v. p. 514 ; Blainville, Ostéog. "Canis," p. 108.
? —— viverroides : see *Cynodon, s.g. Cyotherium.*										
—— brevirostris										*Miocene*, Auvergne. See *Amphicyon brevirostris* ; and *Felis.*
—— Issiodorensis (*See* Felis.)										*Pliocene*, Auvergne, (? = *C. Issiodorensis* vel *C. borbonidus*,) Pictet, Paléontologie, p. 203 ; Blainville, Ostéographie, "Chiens," p. 123, pl. 13 (*C. borbonidus* =) ; *Pliocene*, Issoire, Bravard, Coll. Brit. Mus. ; (= *C. meganastoides*), Pomel, Bull. Soc. Géol. t. xiv. p. 40 ; (? = *Amphicyon*,) Pomel ; Gervais, Pal. et Fr. p. 110.
Canis familiaris fossilis		×	×							*Diluvial*, Europe, Marcel de Serres, Recherches sur les Ossemens Fluviatiles des Cavernes de Lunel-Viel ?, p. 73 ; Pictet, Paléontologie, t. i. p. 203 ; Blainville, Ostéographie, "Chiens," p. 131 ; *Caverns*, France, Belgium, Germany ; *Canis propagator* of Kaup, Isis, 1834, p. 535 (= *C. familiaris*), H. v. Meyer and Bronn, Index Paleontologicus, p. 213 ; Marcel de Serres, Mém. Mus. t. xviii. p. 339.
—— (Lupus) spelæus		×	×							*Caverns*, Europe, Goldfuss, Umgebungen von Muggendorff, t. i. p. 28 ; Nova Act. Acad. Nat. Cur. t. xi. 2, p. 451 ; Cuvier, Ossem. Foss. 4th edit. t. vii. p. 465 ; Owen, British Foss. Mammalia, p. 123 ; Nordmann, Ossem. trouvés près d'Odessa, p. 4 ; *et alii.*
—— ——				?						*Bone-breccia*, Sardinia and France.
—— ——		×								*Diluvial*, Val d'Arno, Fischer (Loup des Tourbières), Bull. Soc. Moscou, 1846, t. xix. ; Paléontologie, ii. p. 391 ; Pictet, Paléontologie, p. 205 ; (*Canis lupus spelæus minor* = *C. spelæus*, vide) Blainville, Ostéographie, "Chiens," p. 103 ; Italy, Wagner, 1829, Isis, t. iv. p. 986.
—— (Vulpes) spelæus			×							*Caverns*, Europe ; Cuvier, Ossem. Foss. 4th edit. t. vii. p. 471 ; Owen, Brit. Foss. Mam. p. 134 ; ? in part species from Auvergne, Pictet, Paléontologie, p. 205 ; Hébert, Fossiles de l'Oise, in Bull. Soc. Géol. ser. 2, t. vi. p. 605 ; Nordmann, Ossem. d'Odessa.

FOSSIL MAMMALIA—*continued.*

× European area. † N. American. o S. American. * African. ‡ Asiatic. § Australasian.

SPECIES.	Alluvial.	Diluvial.	Caverns.	Pleistocene.	Pliocene.	Miocene.	Eocene.	Cretaceous.	Oolitic.	LOCALITIES, AUTHORITIES, AND REFERENCES.
Canis Neschersensis?		×								*Diluvium*, Neschers, near Issoire, Puy-de-Dôme; CROIZET, Coll.; BLAINVILLE, Ostéog. "Chiens," p. 125; GERVAIS, Zool. et Pal. Fr. p. 110; ? = *Canis lycaon*, recent, of the Pyrenees, *fide* BLAINVILLE, *op. cit.*
—— juvillacus?				×						*Pleistocene*, Tour du Bolade, Puy-de-Dôme; BRAVARD (undescribed); PICTET, Paléont. p. 205.
—— medius?				×						*Pleistocene?*, —— ?, BRAVARD (undescribed), *op. cit.* p. 205.
—— Tormellii?			×							*Cavern?*, —— ?, CROIZET (undescribed), *op. cit.* p. 205.
—— Buladi			×							*Cavern?*, —— ?, CROIZET (undescribed), *op. cit.* p. 205.
—— ferreo-jurassicus?	?					?				*Diluvium or Miocene?*, Bohnerz de l'Albe de Souabe, JAEGER (= *Lycotherium* genus); (= *C. lupus ferreo-jurassicus* and *C. vulpes ferreo-jurassicus*, JAEGER,) Foss. Säug. Würt. t. i.; BRONN, Lethæa, t. ii. p. 832; LEONH. and BRONN, Neues Jahrb. 1837, p. 735; PICTET, Paléontologie, p. 205.
—— sp.						×				*Tertiary*, Himalaya, CAUTLEY and FALCONER, Asiatic Journal, 1835?, 559?
—— protalopex			o							*Caverns*, Brazil, LUND (? = *C. Azzaræ*), Mém. de l'Acad. de Copenhague, 1841, t. viii.; PICTET, Paléont. p. 206.
—— sp.	×	×	×							*Diluvial*, *Caverns*, *Alluvial*, Europe.
Canis fulvicaudus?			o							*Caverns*, Brazil, LUND, Mém. de l'Acad. de Copenhague, 1841, t. viii.; Overs. Dansk. Forh. 1842; Isis, 1844, p. 815–819; Ann. Sc. Nat. ser. 2, t. xi. p. 214; (= or near recent *C. fulvicaudus*, LINNÆUS,) PICTET, Paléontologie, p. 206.
—— robustior			o							*Caverns*, Brazil, LUND, *op. cit.* vol. viii.; Ann. Sc. Nat. ser. 2, t. xi. p. 214.
—— lycodes			o							*Caverns*, Brazil, LUND, *op. cit.* vol. viii.; Ann. Sc. Nat. ser. 2, t. xi. p. 214.
—— incertus			o							*Caverns*, Brazil, D'ORBIGNY, Voyage en Amérique; Paléontologie, p. 141, pl. 9, fig. 5.
Cynodon Parisiensis							×			*Eocene*, Gypsum, Paris, AYMARD, Essai sur l'Entelodon, p. 20; Ann. Soc. d'Agr. de Puy, t. xii. p. 244, and t. xiv. p. 112; Monographie des Cynodon, in Ann. Soc. d'Agr. de Puy, 1850, t. xv. p. 92; (= *Viverra Parisiensis*,) CUVIER, Ossem. Foss. 4th edit. t. v. p. 496, pl. 151, fig. 12; BLAINVILLE, Ostéog. "Chiens," p. 109; GERVAIS, Zool. et Pal. Fr. p. 112; (= *Cyotherium*,) AYMARD, Ann. Soc. d'Agr. de Puy, t. xiv. p. 110, 115; (= *Cynodictis*), BRAVARD and POMEL, PICTET, Paléont. p. 208.

										VAIS, *op. cit.* pl. 25 et 26, p. 218.
—— martrides ?						×				*Lower Miocene*, Marnes lacustres, Puy-en-Velay, (= *Elocyon martrides*,) AYMARD, *op. cit.* t. xiv. p. 110; GERVAIS, Zool. et Pal. Fr. p. 219.
Galecynus Œningensis					×					*Pliocene*, Œningen, (= *Canis vulpes*,) MURCHISON, and MANTELL, Trans. Geol. Soc. ser. 2, vol. iii. p. 277, 291, 1830; Phil. Mag. 1830, p. 207; BLAINVILLE, Ostéographie, "Chiens," p. 106; (= *Galecynus*,) OWEN, Quart. Journ. Geol. Soc. vol. iii. 1847, p. 55; (= *Canis palustris*,) H. v. MEYER, in Leonh. und Bronn's Neues Jahrb. 1843, p. 701, and Zur Fauna der Vorwelt, Œningen, p. 4, pl. 1; PICTET, Paléont. p. 209.
Palæocyon troglodytes			o							*Caverns*, Brazil, (LUND, *non* BLAINVILLE, Palæocyon,) LUND, Overs. Danske Forhandl. 1842; (= *Canis troglodytes*,) LUND, Ann. Sc. Nat. ser. 2, t. xi. p. 214, t. xiii. p. 312; PICTET, Paléontologie, p. 209.
—— validus			o							*Caverns*, Brazil, LUND, *op. cit.* 1842.
Speothos pacivora			o							*Caverns*, Brazil, LUND, Mém. de l'Ac. de Copen., t. viii. pl. 19, fig. 1, 2; PICTET, Paléontologie, p. 210.
? Galeotherium sp., JAEGER (*non* WAGNER)						×				*Miocene ?*, Bohnerz de la Molasse de la Souabe supérieure, JAEGER, Foss. Säug. Würt. p. 71, pl. 10, fig. 43–47; PICTET, Paléontologie, p. 221; H. v. MEYER ?, p.
3. VIVERRIDÆ.										
Viverra antiqua						×				*Miocene*, Mont St. Gérand, Auvergne, BLAINVILLE, Ostéographie, "Civettes," pp. 69 and 71, pl. 13; PICTET, Paléontologie, vol. ii. p. 211; (= Civette d'Auvergne,) CROIZET, —— ?; GERVAIS, Zool. et Pal. Fr. pl. 114.
—— primæva						×				*Miocene*, Auvergne, POMEL, Bull. Soc. Géol. ser. 2, t. iii. p. 366.
—— zibethoides ?						×				*Miocene*, Sansan (= Zibeth de Sansan), LARTET, Notice Coll. Sansan, pl. iv. f. 2; BLAINVILLE, Ostéographie, p. 75; Ann. des Sc. Nat. ser. 2, t. vii. p. 119; PICTET, Paléontologie, vol. i. p. 211, Atlas, pl. 4, fig. 2.
—— Sansaniensis						×				*Miocene*, Sansan, LARTET, Notice sur la Colline de Sansan; GERVAIS, Zool. et Pal. Fr. pl. 222.
—— incerta						×				*Miocene*, Sansan, LARTET, *op. cit.*
—— Simorrensis						×				*Miocene*, Simorre, LARTET, *op. cit.*; PICTET, Paléontologie, p. 211.
—— ferreo-jurassica ?						×				*Miocene ?*, Bohnerz de l'Albe de Souabe, JAEGER, Säugeth. 15, t. 5, f. 13, 14; PICTET, Paléontologie, vol. i. p. 212, and p. 205.
—— sp.			×							*Caverns*, Lunel-Viel, MARCEL DE SERRES, DUBREUIL, and JEAN-JEAN, Recherches sur les Cavernes de Lunel-Viel, p. 247.
—— sp.							‡			*Eocene ?*, Tertiary, Bengal, PENTLAND, Trans. Geol. Soc. ser. 2, vol. ii. p. 45, fig. 6.
—— sp. ?			§							*Caverns*, New Holland, CLIFT ?; PICTET, Paléontologie, t. i. p. 212; Sansan, BLAINVILLE; (= *Galerix*,) *vide* PICTET, Pal. p. 212.

FOSSIL MAMMALIA—*continued*.

× European area. † N. American. o S. American. * African. ‡ Asiatic. § Australasian.

Species.	Alluvial.	Diluvial.	Caverns.	Pleistocene.	Pliocene.	Miocene.	Eocene.	Cretaceous.	Oolitic.	Localities, Authorities, and References.
(Viverra *exilis* =) Palæonictis gigante							×			*Eocene ?* (*Suessonien*), Lignites of the Soissonnais, at Muirancourt, near Noyon (Oise), Blainville, Ostéographie, "Civettes," p. 76, pl. 13; Gervais, Zool. et Pal. Fr. p. 131, pl. 25; (= molar of Loutre from *Suessonien* of Meudon,) C. D'Orbigny, Dict. Hist. Nat ?; (= *Canis civerroides* des Plâtrières,) Blainville, Ostéog. p. 76; Pictet, Paléontologie, p. 212; Atlas, pl. 4. fig. 3.
4. Mustelidæ.										
Gulo spelæus			×							*Caverns*, Gaylenreuth, Sömmerring, —— ?; Belgium, Schmerling; France ?, Gervais, Zool. et Pal. Fr. p. 117; Pictet, p. 214; Atlas, pl. 4, fig. 5; Goldfuss, Nova Acta Nat. Cur. ix. p. 314; Cuvier, Ossem. Foss. 4th edit. t. vii. p. 500.
Galictis sp.			o							*Caverns*, Brazil, Lund, (= *Eirara*,) Ann. des Sc. Nat. ser. 2, t. xi. p. 225.
Mephitis sp.			o							*Caverns*, Brazil, Lund, Ann. des Sc. Nat. ser. 2, t. xi. p. 225; Pictet, Paléontologie, p. 215.
Palæomephitis Steinheimensis					×					*Pliocene ?*, Freshwater Limestone, Steinheim, Jaeger, Foss. Würt. p. 78, pl. 10, fig. 7, 8; (= *Palæobassaris*,) Paul de Wurt, —— ?; Pictet, Paléont. p. 205.
Mydaus sp.							×			*Suessonien*, Meudon, Blainville, Ostéographie, "Subursus," p. 47; Pictet, Paléont. p. 26.
Mustela minuta						×				*Lower Miocene*, Auvergne, Gervais, Zool. et Pal. Fr. pl. 27; Pictet, Paléont. p. 216.
—— genettoides						×				*Upper Miocene*, Sansan, Blainville, Ostéographie, "Martes," p. 61, pl. 14.
—— hydrocyon						×				*Upper Miocene*, Sansan, Gervais, Zool. et Pal. Fr. p. 118, pl. 23; (= *Hydrocyon Sansanensis*,) Lartet, Notice sur la Colline de Sansan, p. 17; Pictet, Paléont. p. 216.
—— taxodon						×				*Upper Miocene*, Sansan, Gervais, Zool. et Pal. Fr. p. 118, pl. 23; (= *Taxodon Sansaniensis*,) Lartet, Notice sur la Colline de Sansan; Pictet, Paléont. p. 216.
—— Zorilloides ?						×				*Upper Miocene*, Sansan, Lartet, Notice sur la Colline de Sansan, p. 17; Pictet, Paléont. p. 216.
—— incerta						×				*Upper Miocene*, Sansan, Lartet, Coll.; (= *Thalassides*,) Pictet, Paléont. p. 216.
—— sp.							?			*Eocene ?*, Terrain Tertiaire lacustre, Georgensgmünd, Bavaria, Count de Münster ?; Pictet, Paléont. p. 216.
—— sp.		×	×							*Caverns*, Liége, Schmerling, Cavernes de Liége; France, Gervais, *op. cit.*; Desnoyers ?; Nordmann, Ossem. Foss. trouvés à Odessa; *Upper* [illegible]?, etc.; *Diluvium*, Odessa, [illegible] p. 217.

										p. 205.
Soricictis elegans						×				*Miocene*, Auvergne, at Saint Gérand-le-Puy, POMEL (in coll. M. Feignoux), ? ; (= *Amphichneumon*), POMEL, in Coll. British Museum ; GERVAIS, Zool. et Pal. Fr. explic. pl. 28 ; PICTET, Paléont. p. 213.
—— leptorhyncha						×				*Miocene*, Saint Gérand-le-Puy, POMEL (in coll. M. Feignoux), —— ? ; GERVAIS. *op. cit.* explic. pl. 28.
—— ? sp.							×			*Eocene ?*, *Terrains récents*, Greece (*Eocene* or *Miocene* of Pikermi) ; (= *Galeotherium*), WAGNER, Mém. de l'Acad. de Munich, t. iii. p. 11, pl. 1, fig. 4, 5 (non *Galeotherium*, JAEGER) ; PICTET, Paléont. p. 213.
Paleogale pulchella						×				*Miocene*, Weisenau, H. v. MEYER, in Leonh. and Bronn's Neues Jahrb. 1846, p. 474 ; PICTET, Pal. p. 218.
—— fecunda						×				*Miocene*, Weisenau, H. v. MEYER, *op. cit.* p. 474 ; PICTET, Pal. p. 218.
Putorius zorillinus					×					*Pliocene*, Subvolcanic deposits, Auvergne, BRAVARD, Bull. Soc. Géol. ser. 2, t. iii. p. 205 ; (= *Mustela zorilloides*,) GERVAIS, Zool. et Pal. Fr. p. 251.
—— Sansaniensis						×				*Miocene*, Sansan, LARTET, Notice sur la Coll. de Sansan ; (? =) PICTET, Paléontologie, p. 218.
—— incertus?						×				*Miocene*, Sansan, LARTET, *op. cit.* ; (? =) PICTET, Paléontologie, p. 218.
—— antiquus		×	×							*Caverns*, Pondres (Gard), etc., France, H. v. MEYER, Palæologica, p. 54 ; (= Putois fossile,) CUVIER, Ossem. Foss. 4th edit. t. viii. p. 484 ; Lunel-Viel, M. DE SERRES, Recher. sur les Cav. de Lunel-Viel ; *Diluvium*, Avaray, near Beaugenez ; *Caverns*, Liége, SCHMERLING, Cav. de Liége ; Kirkdale, BUCKLAND, Rel. Dil. ; *Breccia*, Vendargues (Hérault) and Montmorency.
—— vulgaris?		×								*Diluvium*, Gravels, neighbourhood of Geneva, PICTET, Paléont. p. 218 ; Auvergne, POMEL, Bull. Soc. Géol. t. iii. p. 204.
Mustela vulgaris		×	×							*Diluvium*, Geneva, Auvergne, POMEL, Bull. Soc. Géol. t. iii. p. 204 ; PICTET, *op. cit.* p. 218 ; *Caverns*, Kirkdale, BUCKLAND, Rel. Dil. ; CUVIER, Ossem. Foss. 4th edit. t. vii. p. 500 ; Liége, SCHMERLING, Cav. de Liége.
Putorius ermineus		×								*Diluvium !*, Osseous Breccia, environs of Beremend, near the Drave, LEONH. and BRONN, Neues Jahrb. 1851, p. 679 ; OWEN, Brit. Foss. Mam. and Birds, p. 116.
—— furo ?		×								*Diluvium*, Auvergne, POMEL, Bull. Soc. Géol. t. iii. p. 204.
—— nudipes?		×								*Diluvium*, Auvergne, POMEL, *op. cit.* t. iii. p. 204.
Putoriodus sp.						×				*Miocene*, Calcaires lacustres, environs of Issoire, Auvergne, GERVAIS, Zool. et Pal. Fr. explic. pl. 27 ; PICTET, Paléont. p. 219.
Lutra dubia						×				*Miocene*, Sansan, LARTET, Notice sur la Colline de Sansan ; BLAINVILLE, Ostéographie, "Martin," p. 76, pl. 14 ; PICTET, Paléont. p. 219.

× European area. † N. American. o S. American. * African. ‡ Asiatic. § Australasian.

Species.	Alluvial.	Diluvial.	Caverns.	Pleistocene.	Pliocene.	Miocene.	Eocene.	Cretaceous.	Oolitic.	Localities, Authorities, and References.
Lutra Bravardi					×					*Pliocene*, Issoire and Perrier, Pomel, Bull. Soc. Géol. t. xiv. p. 168, pl. 3, fig. 1, 2; (= *L. claveris*,) Croizet, in Huot?, Cours de Géologie, t. 1, p. 265; (= in part *L. Clermontensis*,) Croizet, *op. cit.*; Pictet, Paléont. p. 219.
—— antiqua		×								*Diluvium*, Fens, Cambridgeshire, H. v. Meyer, Palæologica, p. 55; Pictet, Paléont. p. 220.
—— spelæa?			×							*Caverns*, Lunel-Viel, M. de Serres, Cav. de Lunel-Viel, p. 70; Pictet, Paléont. p. 220.
—— ferreo-Jurassica?						?				*Miocene?*, Bohnerz of Souabe, Jaeger, Foss. Säug. Würt. p. 13; Pictet, Paléont. p. 220.
Potamotherium Valetoni						×				*Miocene?*, ——?, Geoffroy Saint-Hilaire, Études Progressives d'un Naturaliste, p. 91; (=? *Lutrictis*;) *Miocene*, Calcaire lacustre d'Auvergne, Saint-Gérand-le-Puy, Pomel, Bull. Soc. Géol. ser. 2, t. iv. p. 380, pl. 4, fig. 5; (=?) Pictet, Paléontologie, p. 220; Atlas, pl. 4, fig. 10; (=? *Stephanodon*,) H. v. Meyer, in Leonh. and Bronn's Neues Jahrb. 1847, p. 143; (=? *Monbachensis*, in British Museum;) Gervais, Zool. et Pal. Fr. explic. pl. 28.
Plesiogale angustifrons						×				*Lower Miocene*, Limestone, Saint Gérand-le-Puy, Allier, Bull. Soc. Géol. sér. 2, t. iv. p. 385; Laurillard, in D'Orbigny's Dict. de Nat. Hist. t. x. p. 268; Pictet, Paléont. p. 217, Atlas, pl. 4, fig. 7; Gervais, Zool. et Pal. Fr. p. 119.
—— elegans						×				*Miocene*, Saint-Gérand-le-Puy, Auvergne, Pomel, Coll. British Museum; Pictet, Paléontologie, p. 217.
—— sectoria						×				*Miocene?* Cournon?; (= *Plesiogale*,) in coll. British Museum; (= *Mustela sectoria*,) Gervais, et Pal. Fr. explic. pl. 28; Pictet, Paléont. p. 217.
Plesictis sp.						×				*Lower Miocene*, Limestone, Saint-Gérand-le-Puy, Pomel, Bull. Soc. Géol. ser. 2, t. iv. p. 379; (= *Mustela plesictis*,) Laizer and Parien, Mag. de Zool. 1839, pl. 5; Laurillard, in D'Orbigny's Dict. Univer. d'Hist. Nat. t. x. p. 268; Blainville, Ostéographie, p. 62, pl. 14; Gervais, Zool. Zool. et Pal. Fr. p. 119.
—— Croizeti						×				*Lower Miocene*, Limestone, Saint-Gérand-le-Puy, Pomel, *op. cit.* p. 380; Pictet, Paléontologie, p. 218; Atlas, pl. 4, fig. 8.
Thalassictis robusta						×				*Miocene*, Marine beds of Bessarabia, Nordmann, Oss. trouvés près d'Odessa?; Pictet, Paléont. p. 221; Gervais, Zool. et Pal. Fr. p. 20. [illegible]

	A.	D.	C.	PL.	P.	M.	E.	CR.	O.	
5. **Hyænidæ.**										
Hyæna hipparionum					×					*Pliocene*, Dépôt fluviatile à Hipparions de Cucuron (Vaucluse), Gervais, in Ann. Sc. Nat. ser. 3, t. v. p. 261; Zool. et Pal. Fr. p. 121, pl. 12, fig. 1; Pictet, Paléontologie, p. 222, pl. 5, fig. 1–6?
— sp.					×					*Pliocene*, Marine sands, Montpellier, Gervais, Zool. et Pal. Fr. explic. pl. 30; Pictet, p. 222.
— sp.						×				*Miocene*, Molasses de la Molière, near the Lake of Neufchâtel, Pictet, p. 222.
— Perrieri					×					*Pliocene?*, Terrains meubles, montagne de Perrier (terrains Tertiaires supérieurs), Puy-de-Dôme, Croizet and Jobert, Recher. Ossem. Foss. du Puy-de-Dôme, p. 169; Pictet, Paléontologie, p. 223.
— Arvernensis					×					*Pliocene?*, Terrain alluvio-volcanique ancien de Vialette, Puy-en-Velay (communication inédite de [illegible]

; Trichechus.—"The teeth of the sea-horse are frequently found places of the Arctic turf-marshes bordering on the Frozen Sea, are so fresh that they are sold in commerce for ivory. In the Penschin there was one of these teeth dug out that was 8¼ lbs. in and another in Kamtchatka weighing 5¼ lbs. (*P. Nordmann*, A tooth of a bluish colour was found at the mouth of the Tagil." ct from Georgi, (Nat. Hist. Russia) 'Beschreibung des Russischen vol. iii. p. 591, by S. J. M.

Deposit at New Iberia.—The rock-salt at this place in Louisiana most extensive and wonderful description, and of great purity. One in account says:—"Imagine the granite quarry of Massachusetts, iarble quarry of Vermont, to be solid deposits of pure rock-salt, d transparent as so much clear white ice in one solid inexhaustible derlying the earth, and you will then acquire an imperfect idea of ness of this salt formation."

ral Formation of Carbonate of Soda.—In the 'Pharmaceutical ' for July, Dr. Haines, of Grant College, Bombay, gives an account iatural production of carbonate of soda in the neighbourhood of It occurs in the form of irregular, colourless, partly crystalline apparently of two distinct portions: one a brilliant, confusedly ne mass, amongst which the angles of cubical crystals could be d; the other, a white amorphous substance, of a greasy feel and dour, very similar to crude borax. By analysis, the composition on as:—

Neutral carbonate of soda	51·05
Common salt, with traces of sulphate of soda and chloride of magnesium	21·94
Water and organic matter	19·66
Sand	4·35
	100·00

in Playfair, Assistant Political Resident at Aden, states that this co is found all along the coast to the east of Aden to an extent of ten miles, and its quantity is practically unlimited. It is usually n hollows behind (or beyond) high-water mark to which the sea ias access by percolation. There is no demand for it at present, ie months ago, sixty to seventy camel-loads a day were brought en, and met with a ready sale at 2½ rupees per ten maunds (equal shillings a hundredweight). The only use made of it is to mix with increase the pungency; rarely, too, it is used for washing clothes. riously called by the Arabs *Dukduka*, *Hurka*, and *Kúra*.

the valuable paper published by Mr. H. J. Carter in the Trans- of the Bombay Branch of the Royal Asiatic Society, on the of Arabia, it appears that the whole of the south-east coast of from Rus-al-Had to Bab-ul-Mandib, is capped with nummulitic ie, pierced at frequent intervals with basaltic effusions, and in laces elevated so as to form lofty and abrupt cliffs, in which, be- he limestone, other formations are visible. As a result of this for- the shingle on the coast consists mainly of limestone; and although ific description of the coast immediately to the east of Aden has ven, there is no reason to doubt that the same peculiarities prevail It is then to the percolation of sea-water through a stratum of its of limestone that we must attribute the production of the car- of soda, by which percolation, probably, a partial interchange of

FOSSIL MAMMALIA—*continued*.
× European area. + N. American. o S. American. * African. ‡ Asiatic. § Australasian.

elements has been effected between the chloride of sodium and the carbonate of lime, giving rise to the formation of chloride of calcium and carbonate of soda. It has been long suspected that the natural production of carbonate of soda was dependent on the presence of carbonate of lime, and was brought about somewhat in this way; but what the conditions are under which the separation of the carbonate of soda from the chloride of calcium is effected, without allowing the former to exert its ordinary converse action upon the lime-salt and reproducing carbonate of lime, is a question that would form a very interesting subject of scientific inquiry. This is, I believe, the first time that the natural production of alkali from sea-water itself, without organic agency, has been observed.

It is hardly probable that the production of carbonate of soda in this way is limited to a few miles' distance from Aden. As the shore is so very similar along the whole 1125 miles which form the south-east coast of Arabia, there is a reasonable expectation of finding it at many places elsewhere; and an article so much in request, so easily procured, and with water-carriage close at hand, might yield a fair amount of profit to an enterprising shipper who should collect or purchase it upon the spot.

Lake Superior Silver.—The silver found at Lake Superior is native, and is the most extraordinary metallurgical paradox yet discovered, in which nature has shown that she can completely surpass art. It is found in large quantities in the native copper mines of that district. The combinations of the silver with the copper present most varied forms; in some instances the native silver is found running through a mass of native copper in veins of varied thickness, like veins in marble; at other times it is found attached to masses of copper, in many beautiful floriated forms of a large size and sometimes resembling the stumps of old trees, and frequently covering the whole surface of a mass of copper on all its sides to a considerable thickness, and presenting most beautiful forms in cubes, prisms, and four-sided pyramids, which appear as though the whole mass of copper had been thickly electrotyped with the precious metal. Its varied forms and its extreme purity, although in conjunction with the copper, renders it a subject of the greatest curiosity, both metals having been, some think, subjected to a heat that must have been equal to a refiner's smelting-heat, and yet the metals are each found in perfect purity. In all the mass of copper of this vast district, silver is associated with it to a greater or less degree, but not in sufficient quantity to pay for its separation. The rock in which the silver of this district most abounds is an amygdaloidal trap of a very compact nature. The miners of this district for many years considered the native silver as a perquisite,—as they used to say they were employed to mine for copper and not for silver; therefore the proprietors rarely used to get the silver, but the miners always had an abundance. This state of things now no longer exists, and the proprietors get a large share of this valuable production.

In a contribution to the 'Washoe Times,' Mr. J. B. Truckee states that he had the most valuable collection from the Superior mines in Europe, which he was solicited by the commissioners for mines and minerals to place in the Paris Exhibition as an illustration of the productions of the mines of Lake Superior, they undertaking to return the collection intact when the Exhibition closed; but at the time when he looked for its return, he was waited upon by two gentlemen, who came from the Emperor of France, to request that the collection might remain at the School of Mines in Paris. As Mr. Truckee considered this school the first of its class, he consented to his collection remaining there.

In this collection there are crystals of pure native copper in clusters of perfect cubes, to which are attached floriated native silver.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

GEOLOGICAL SOCIETY.—*June 17th.*—1. "On the Relations of the Cromarty Sandstones containing Reptilian Footprints." By the Rev. George Gordon, LL.D., and the Rev. J. M. Joass. With an Introduction by Sir R. I. Murchison.

In the introduction Sir R. I. Murchison gave a sketch of the geology of the Tarbatness promontory, which is composed of variously coloured sandstones, having a conformable dip to the N.W. In these strata the authors had found footprints (of animals believed to be Reptiles) similar to those found in the sandstones on the coast of Elgin; and it was therefore desirable to prove whether these rocks really belonged to the Palæozoic series, or, as some geologists suppose with regard to the Elgin sandstones, to the Trias. In order to solve this problem, if possible, the Rev. Mr. Joass made a careful survey of the coast from Geanies to Tarbatness Lighthouse, and round along the north shore of the promontory to the inlet at Inver, and found a conformable succession between the undoubted Old Red Sandstone of Geanies and the track-bearing sandstone of Tarbatness.

The Rev. Dr. Gordon gave a description of the various tracks; the smaller kind are referred by him to an unknown Crustacean; the larger and more definite impressions, however, he considered to be the footsteps of some kind of reptile. He also stated, as confirmatory of the "Old Red" age of the beds, that the Oolitic beds of Shandwick are unconformable to the Old Red Sandstone.

2. "On some Tertiary Shells from Jamaica." By J. Carrick Moore, Esq. With a Note on the Corals, by P. Martin Duncan, M.B. London; and a Notice of some Foraminifera, by Professor T. Rupert Jones.

An examination of seventy-one species of Tertiary Mollusca from Jamaica, mostly collected by the late Mr. Barrett, showed that twelve are still living, and that twenty-eight are common to the Tertiary beds of Jamaica and St. Domingo. The same relation between those deposits had been found to exist by Dr. Duncan through a comparison of the corals. The "Pacific" affinity of many of these shells and corals was noticed as confirmatory of a conclusion arrived at by the author in a former paper; and it was shown, from the occurrence of Tertiary beds on the Panama Isthmus at a height of 250 feet above the sea, that the complete separation of the Atlantic and Pacific Oceans did not take place until after the commencement of the Tertiary period. The distribution and affinities of the Nummulina and Orbitoides were described by Professor Jones, and those of the Corals by Dr. Duncan.

3. "On the Geology and Mineralogy of a part of Borneo." By M. Cornelius de Groot.

A collection of specimens from Borneo and Java, presented by the author to the Museum of Practical Geology, was accompanied by some explanatory notes, in which it was stated that the steam-coal of Borneo underlies the Nummulitic formation, and probably belongs to the "Étage Suessonien" of D'Orbigny. The occurrence of tin in steam-works, and as veins in granite, at several places in the western portion of Borneo and the islands of Blitong and Banka, was particularly described, as well as the presence of ores of copper and manganese. Some Tertiary fossils from Borneo and Java were also noticed.

4. "Description of a new Fossil Thecidium from the Miocene Beds of Malta." By J. Denis Macdonald, Esq.

Amongst the many fossils occurring in the lower part of the Calcareous ıe of Malta is a small Thecidium, nearly allied to *T. Mediterranea*, :h smaller than that species, and, on close inspection, having d very decided specific distinctions. Mr. Macdonald gave a de-escription and figures of this new species, and proposed for it the *Thecidium Adamsii.*

ʼn the Sandstones and Shales of the Oolites of Scarborough, with ions of new Species of Fossil Plants." By J. Leckenby, Esq.

rue position of the well-known plant-bed at Gristhorpe Bay, be-grey limestone, was first pointed out by Professor Williamson, rwards by Dr. Wright; and Mr. Leckenby showed that all the itherto referred to the Upper Sandstone, Shale, and Coal, belong ,ower Sandstones and shales, but few plants having been found rue Upper Sandstones and shales overlying the grey limestone. ıor gave lists of fossil plants occurring in the two sets of strata, as of those occurring at the separate localities; and he con-ɔy describing some new and some imperfectly known species of

ι Monograph of the Ammonites of the Cambridge Greensand." ieeley, Esq.

xcavations in the Upper Greensand of Cambridge have furnished ley with an opportunity of examining a great number of specimens lifferent species of Ammonites occurring in that formation, and he ımunicated the results of his examinations to the Society, giving descriptions of the species.

)n a new Crustacean from the Glasgow Coal-field." By J. W. Ssq.

revious paper the author collected together what was known of :rurous Crustaceans of the British Coal-fields; since then, Mr. :ussell has discovered a new species, remarkable on account of the les being larger than the antennæ, and which Mr. Salter now de-.n detail.

ʼn the Occurrence of a Bituminous Substance near Mountgerald, l." By Dr. G. Anderson.

ection exposed by some deep cuttings for the Ross-shire Railway, :s north of Dingwall, exhibits a grey, micaceous, and almost hori-onglomerate, traversed by fissures containing a black bituminous :e, which the author stated might have infiltrated down from a bed ıinous schist which apparently overlies the conglomerate.

ʼn the Occurrence of Albertite at Mountgerald, Scotland." By ackenzie, Esq.

.king a drain on a farm near Mountgerald, a fissure was discovered ɔntained a bituminous substance very similar to the Albertite of ·unswick; a deposit of a similar nature was also discovered in a cutting through "The Crag," near Mountgerald. The author d the stratigraphical and lithological characters of the rocks met making this cutting, and stated that as many as thirty-six veins ng this mineral were passed through.

On the Occurrence of Rocks of Upper Cretaceous Age in Eastern ' By Dr. T. Oldham.

g the years 1851–52, the author examined the rocks of the Khasi . Eastern Bengal, and made a collection of the fossils occurring These fossils were mostly from a Nummulitic Limestone, and were y of Eocene date; but some were obtained from a sandstone ıng this limestone, and appeared to be of Cretaceous rather than

Tertiary age. Unfortunately they were lost during their transmission to England; tbut the author gave a list of genera and of some species since obtained.

Manchester Geological Society.—*June 30th.*—Mr. Joseph Goodwin presented to the Society two specimens of shale; one from the Jet Amber Mine, Haughton, containing minute shells of Anthracosia, and the other from the Peacock Mine, Hyde, containing beautiful specimens of ferns (Pecopteris), etc. A vote of thanks was passed to Mr. Goodwin for his donation.

A collection of fossil fishes, consisting of Megalichthys, Helodus, etc., from the roof of the Spanish Juice or Half-yard Mine at Carr Knol, near Oldham, was presented by Mr. John Butterworth, of Moorside, Oldham. Mr. Wilde, of Moor Edge, sent for exhibition a fossil plant found in the sandstone at Oldham Edge, which he thinks proves that Halonia is but the root of Lepidodendron This connection of the two plants, Mr. J. S. Dawes, F.G.S., of Smethwick House, asserted he had proved many years since.

The paper read was "On the Effect produced on Rowley Rag by Heat, and the practical Application of its Products to useful Purposes," by Mr. J. Plant.

The author's object was to give an opportunity for the examination of a series of specimens which were obtained from Mr. Henry Adcock, the inventor and patentee of the Basaltic Stone Works at Oldbury, Worcestershire; these works, and nearly all similar works for the conversion of basalts and vitreous slags to ornamental purposes, having been discontinued, opportunities will consequently rarely occur for the examination of the interesting results of these experiments.

The question as to the changes which heat has effected in the constitution and crystallization of certain igneous rocks has ever been one of great interest to the geologist; and with a view to explain certain theories upon the columnar structure and prismatic form of basalt, as observed generally, but more especially at the Giant's Causeway, Staffa, and the hill at Rowley Regis, experiments were conducted as early as the year 1804, by Mr. Gregory Watt; which experiments established the fact that basalt and trap were igneous rocks, and that the columnar structure of basalts could be experimentally produced under certain conditions of heat and pressure. Rowley Rag has been described by Senft as Melaphyre, an indistinctly mixed rock, intermediate between ordinary greenstone and black basalt, of dirty greenish-brown, hard and tough in a fresh state, having a specific gravity of 2·85, and a composition of silica, 55; alumina, 25; oxides of iron and manganese, 12; lime, 8; soda, 6; and inappreciable amounts of potash and magnesia. Mr. Watt fused 700 cwt. of this material, and kept it in a furnace several days after the fire was lowered. It fused into a dark-coloured mass, of a vitreous character, with less heat than was necessary to melt iron; and a portion which was taken out whilst the mass was in fusion, and cooled quickly, became perfectly glassy. As refrigeration proceeded in the mass it became changed into a stony substance, and globules appeared; these enlarged till they pressed laterally against each other, and became converted into polygonal prisms. The most important result observed was the formation of spheroids, sometimes extending to a diameter of two inches. They were radiated with distinct fibres, in somewhat concentric layers; but the centres of most of the spheroids became perfectly compact before they attained the diameter of half an inch. This structure gradually pervaded the whole body of the spheroid. A coninuation of the temperature speedily induced another change; the texture of the cooling material became more granular, its colour more grey, and the brilliant points larger and more numerous. These brilliant molecules arranged themselves in regular forms, and finally the whole mass became pervaded with thin crystalline laminæ. Mr. Watt applied these facts in explanation of the globular structure which is observed in decomposing basaltic rocks; but as similar experiments have been often repeated, the results are familiarly known to every geologist, and need not be further alluded to in this paper. Sir James Hall, in 1805, conducted experiments illustrating the crystalline arrangements and texture assumed by basaltic rocks when fused and cooled under high pressure. He established the fact that most rocks of presumed igneous origin, when fused, yielded different products according to the differences in the amount of pressure under which they were cooled. Thus, when the rate of cooling was rapid, they formed a black amorphous glass; and when the cooling was slow, a strong mass with a granular structure. The same materials yielded the most dissimilar products,—a fact that is of the greatest importance in reference to the study of the nature of eruptive rocks, and of the metamorphic action which they occasion. These discoveries were chiefly valuable from their philosophical bearing upon contested points in the science of geology; and it was not until the year 1846 that any attempt was made to turn them to a practical and economical value. At that time, acting upon the results of some experiments which had been made upon the Continent, a Mr. Jean Michel Borgognon took out a patent in England for the manufacture of articles of utility in what he termed artificial basaltic lavas. His invention claimed the discovery of operating upon stony substances, but chiefly upon the vitreous slags from iron furnaces. These were fused at a high temperature, and run into moulds of cast-iron or refractory clay, the moulds being heated in the interior by means of a powerful flame, kept up by a blast. Colouring matter, from the oxides of iron and other metals, was mixed with the fused materials, and great diversity and beauty was thereby obtained in the vitreous ornaments. It does not appear, however, that any great application of his patented lavas was made in England. In the year 1851 Mr. Henry Adcock, a civil engineer, of Oldbury, took out the first patent for the production of bricks, tiles, pipes, etc., from the fused trap of Rowley Regis. This gentleman had been led to the application of this material from experiments which he had commenced in the year 1834. He then fused some Rowley Rag in a common kitchen-fire; and being much impressed with the beauty of the black glass as it fell on the hearth, he perceived that it might probably possess great practical value. He obtained the use of a reverberating furnace, and conducted his experiments upon a larger scale. In 1851 a patent was obtained, in which the inventor claimed for his discovery the melting the stony material known as Basaltic Trap, Rowley Rag, or Whinstone, and running the same when in a fluid state into moulds. The materials were heated in a reverberating furnace, either at the bottom or in crucibles, and then cast into cast-iron moulds put together with iron cramps. The fused trap was run into the moulds, when both were brought into a state of white heat. If it were intended to give a polished surface to the casting, the cast-iron mould was highly polished and coated with plumbago, also highly polished. If the fused materials were allowed to cool at a gradual and slow rate of cooling, the result was a hard stony rock, scarcely to be distinguished from the original trap from Rowley Regis; but a less degree of heat, with a quicker rate of cooling, caused the materials to assume the appearance of a mixed marble;

and a rapid rate of cooling produced a black glassy substance, quite opaque, unless it was cast very thin, and then it became semi-transparent. If it were desired to run the fused materials more quickly, a flux, such as soda, effected such a result. The practical utility of this invention became widely known, and an extensive application of it was made in ornaments of an architectural character, mantelpieces, window-sills, window-heads, string courses, capitals of columns, and monumental slabs, which were all cast from Rowley Rag; and these, from the almost imperishable nature of the material, are likely to endure for ages. For reasons which it is not necessary to state, the works did not long continue, and have since been taken down. In 1852 Mr. W. G. Elliott, Blisworth, took out a patent for the manufacture of pipes and other articles from mixed brick clay, limestone, ironstone, and oyster-shells. The product was a greenish-black vitreous material when run into press-moulds and afterwards annealed. There is very little difference between this application and that of Mr. Borgognon, and it added nothing which was not well known in the effects of heat upon minerals. In 1854 a patent was taken by Mr. J. T. Chance, of Birmingham, claiming improvements in the manufacture of articles from the mineral called Rowley Rag, in which the principal discovery, in addition to what had been known of its fusibility and of its adaptation for casting in moulds, was, that the fused mineral, unlike cast-iron, was capable of being rolled or pressed into the form of slabs, sheets, bars, and rods, all either with plain or raised ornamental surfaces. In fact, it could be treated in the same manner as plate-glass and some of the ductile metals; but articles manufactured in this way required to be subjected to the process of annealing. Another discovery was made about this time, in which it was shown that it was possible to mix a quantity of coloured glass with the fused Rowley Rag, for the specific gravity of basalt and common glass, when in a state of fusion, are nearly alike, and advantage was taken of this to produce sheets of the material which, when polished, resemble the rich and beautifully-coloured serpentines of Cornwall. In fact, there was no limit to the variety which could have been obtained by the admixture of these two and other substances, the only point of any scientific interest in the matter being that the two materials did not chemically combine, even with the greatest amount of care and skill. They were only mechanically mixed together, and the result is well shown in the specimens upon the table. In 1855 Mr. Chance and Mr. Adcock took out a further patent for improvements in casting articles from the slags of iron furnaces, but this chiefly related to the machinery and method of casting in sand moulds in place of the iron moulds first used by Mr. Borgognon; and since this date no further discoveries appear to have been made in the practical application of the basalts and traps for economic purposes, or in the aid of the decorative arts.

The specimens exhibited by the author, in illustration of his paper, were obtained from Mr. Adcock, the inventor and proprietor of the Basaltic Stone Works, at Oldbury, Worcestershire, after the works were discontinued; namely, Rowley Rag in its natural state; a shining opaque glass—artificial obsidian—the common result of the Rowley Rag when cooled very quickly; specimen showing the conchoidal fracture, which is common to the fused as well as to the natural state of the Rowley Rag; specimens showing different amounts of recrystallization in accordance with the rates of cooling (in one the greatest degree of change ever obtained was shown, other than its entire conversion into basaltic stone); a specimen showing that in some instances the recrystallization takes place in bands; a casting of part of an ornament, exhibiting its perfect reconversion to the Rowley Rag; a specimen broken from a large mass of the recrystallized basalt; specimen resembling a natural vesiculated lava [when fused the Rowley Rag is very viscid, therefore, if a piece of wood, coal, or any other substance which will give off gas be plunged into it, the escaping gas will produce this vesiculated structure); specimens from the bottom of the furnace, in which the quartz gravel lining the furnace has become embedded in the melted lava (these are very similar to the toadstones and amygdaloid porphyries frequently met with in basaltic districts); a portion of the congealed coating which is instantaneously formed in the ladle used in pouring the melted matter into the mould (this is very similar to the crust which is observed on flowing lava from a volcano, and in a great measure preserves the under mass from cooling quickly; it was turned to advantage in casting, as the fused basalt would remain for more than an hour in the ladle when thus coated, and experience taught the workman that fused metal so retained made castings of a superior character; when a ladle was once coated to the thickness of half an inch it gained comparatively little in thickness, even when refilled three or four times); polished specimens of Mr. Chance's rolling of the obsidian glass from ⅛ of an inch to ¾ thick, used as a substitute for roofing slates, Bath tiles, and inlaid work for halls (these sheets were rolled 8 feet long by 3 feet 8 inches, and were readily cut into lengths with a glazier's diamond; some were coloured by a mixture of glass; one had a design engraved upon the polished surface by means of fluoric acid, showing its adaptability for this character of decoration; one had a large percentage of glass and was coloured by a metallic oxide); artificial obsidian, cast in a cold iron mould; another specimen cast in a heated iron mould; part of an obsidian pipe, cast in a heated iron mould; another pipe cast in a damp sand mould; a hollow column, 6 feet high, 7 inches diameter (1 inch thick of this resisted a pressure of 300 tons; a pipe 4 inches in the bore and ½ an inch thick resisted an hydraulic pressure of 220 pounds); artificial obsidian, with fine conchoidal fracture; three specimens of artificial obsidian.

Signor Berruti, of the Royal Geological Survey of Italy, said that in the course of his geological researches he had been in different volcanic districts where rocks occurred resembling the specimens on the table; he had had frequent opportunities of examining streams of lava which showed all the varieties of texture from compact basalt to those of obsidian and pumice. What he had seen made him quite agree with the views expressed in Mr. Plant's paper. In the neighbourhood of a volcano might be seen rocks of considerable thickness which at the top consisted of obsidian or volcanic glass, lower down the texture was of a duller and more earthy or stony character, and lower still, where the mass must have been a long time in cooling, it was very similar to basalt or Rowley Rag, being hard and of a sub-crystalline texture. It appeared quite clear that parts of the same mass of lava became a compact, stone-like basalt when cooled slowly, and other parts, when cooled rapidly, became obsidian; for near Naples a stream of lava, which had flowed into the sea, was converted into obsidian where it had been immersed in the water and quickly cooled; whereas, on the land, where the lava had cooled slowly, it had become more crystalline and approximated in texture to basalt,—the material being evidently similar in both instances. In Italy an attempt had been made to turn it to some use, and to a certain extent the experiments had been attended with success. At the same time it was not yet considered that the success was complete. He did not consider that the moulded ornaments manufactured from fused basalt had a tendency to decay or become decomposed by exposure to the atmosphere. He believed they would be found very durable when used in buildings. Mr. Atkinson asked if in the section of a bed of lava, for instance of the depth of 15 or 20 feet (or of the height of this room), the lowest portion which had sustained the greatest pressure, or the part which had been longest in cooling, ever assumed a crystalline structure similar to granite? Signor Berruti replied that the material was more compact, and showed traces of crystalline structure, but the crystallization was very different from that of granite.

Mr. Hull said if there was one question more than another we might consider absolutely settled in geology—though some geologists deny that anything at all has been settled—it is that these different varieties of trap, passing from greenstone and basalt into obsidian, are the result of differences in the rate of cooling under pressure. But when we come to the question with regard to granite, there, at once, we perceive a distinction. There is something very different and distinct between granite and lavas and other trap rocks. The great question is, why there should be such a distinction. We all know that granite is a highly crystalline rock, and the reason that we failed in making any approach towards forming granite by artificial processes of cooling is that we are attempting to do, on a small scale, what nature does on an enormous one, and with overwhelming forces and length of time, in her own laboratory. We can make no approach to the enormous pressure that nature has been able to employ during the cooling of the granite; nor can we lengthen out the time which granite has taken to cool within the bowels of the earth. It is now known by clear observations, some of which have been made in Dartmoor and other parts, that granite is nothing else but the melted stratified rock, passing sometimes into slate rocks; and so gradual is this passage, that it is sometimes difficult to say where one form of rock commences and the other ends. This shows us that granite is the result of metamorphism of the stratified rock at an enormous depth, in all probability when the rock was overlaid by many thousands of feet of strata, which have been since removed. Thus, in Devonshire, in the case of the granite of Dartmoor, the bosses of granite which appear there lie in the very strike of the beds, and occupy the place of certain members of the slate-rocks of that district. Nothing could better prove that granite is a highly-metamorphosed form of stratified rocks. The President, Mr. Dickinson, remarked that Mr. Hull has told us about the numerous points which have been settled in geology, and that if there is any one which is settled it is this one. He had now been a long time engaged in pursuits which have given him very great opportunities for observing the geological structure of the earth. In the course of those opportunities he had examined rocks similar to those exhibited to-day, both in Northumberland, Cumberland, Durham, Westmoreland, Cornwall, Devonshire, North Wales, and in many portions of Scotland, at the Giant's Causeway and Fair Head, in Ireland, also in the south of France, in Saxony, and in the Hartz Mountains, and other places; and as the result of his observations he was prepared to admit that the fusing of these rocks does give results similar to those that are occasionally found in nature; but with regard to the origin he was disposed to think geologists have settled far too much, and will have to unsettle a good deal of what they have decided upon. The way in which many of the trap rocks are found blended with the slates, etc., was to his mind a point of difficulty to be got over before we can recognise them as being formed by igneous action. The way in ich what are called the floating whins of Scotland are found interspersed th the coal-measures lying in a semi-stratified slate, and which are supsed to have emanated from a chimney and overspread the coal-measures, s caused them to be quoted as of igneous origin. For himself he had ver met with a chimney, nor with any person who had seen one. He d sunk shafts through these trap or basalt rocks, and had seen no differce as he proceeded downwards. There has been uniform structure roughout. He had also made many experiments with them; and he and generally there is a difference in what is obtained after melting, ere being on the whole a more glassy structure obtained. The variation the crystalline structure which Mr. Plant had pointed out was certainly ry interesting, but it may possibly be accounted for otherwise than by e manner of cooling. He knew that the structure of certain metals came varied by different processes of cooling, and that certain metals hen mixed together become crystallized sooner than others, and have a ndency when cooling to form aggregations; and upon this beautiful law founded Pattinson's method of extracting silver from lead. By analysis had found out that when there is a granular structure of the scoriæ om the blast furnaces of iron works, they generally contain more iron an those which have a glassy structure, and by this structure he could ll to within one or two per cent. how much of iron the cinder contained. Ie thought under all the circumstances we should do wisely to regard cts and observations simply as such, without being too hasty in jumping conclusions. The scoriæ and remains of volcanos are different from trap ock.

Another paper, "On the Liberation and Drainage of Gases from Coal-Mines," by Mr. Joseph Goodwin, was read.

MISCELLANEOUS NOTICES.

The Fifteenth Annual Report of the Regents of the University of New York on the Condition of the State Cabinet of Natural History and the Historical and Antiquarian Collection annexed thereto (Albany, 1862), by Professor Hall, has the merits of conciseness, one page sufficing to state all that is wanted to be given on the general state of affairs. In the other portion of this report, which more immediately concerns us, it is stated, some of the results of Professor Hall's investigations in palæontology are communicated in anticipation of the publication of the volumes on the Natural History of the State. The species described by Professor Hall are:—

GASTEROPODA—*Platyceras subrectum, P. attenuatum, P. concavum, P. conicum, P. ketis, P. erectum, P. carinatum, P. Bucculentum, P. symmetricum, P. rictum, P. cymium, P. fornicatum, P. crassum, P. ammon, P. dumosum, P. echinatum, P. argo, Platyostoma lineata, Pl. strophus, Strophostylus unica, Pleurotomaria arata, P. lucina, P. loris, P. unisulcata, P. lineata, P. capillaria, P. trilix, P. sulcomarginata, P. rotalia, P. euomphaloides, Cyclonema Hamiltonæ, C. lirata, C. multira, Macrocheilus Hebe, M. Hamiltoniæ, M. macrostomus, Murchisonia desiderata, M. turricula, Loxonema ylida, L. ? subattenuata, L. robusta, L. Delphicola, L. Hamiltonæ, Euomphalus clymenioides, E. laxus, E. Eboracensis, Bellerophon curvilineatus, B. pelops, B. acutilira, B. patulus, B. rudis, B. leda, B. lyra, B. otsego, E. thalia, Phragmostoma natator, Cyrtolites pileolus, C. ? mitella, Theca ligea, Conularia undulata.* CEPHALOPODA—

Clymenia complanata, C. erata, Trochoceras discoideum, Gyroceras trivolvis, G. Matheri, G. undulatum, G. nereus, G. eryx, G. cyclops, G. nais, G. (Cyrtoceras?) spinosum, Cyrtoceras eugenium, C. jason, C. maroum, C. metula, Aploceras (Cyrtoceras) liratum, Gomphoceras beta, Orthoceras pelops, O. tetricum, O. foliatum, O. bacchus, O. thoas, O. hyas, O. multicinctum, O. profundum, O. subulatum, O. constrictum, O. exile, O. crotalum, O. nuntium, O. pernelegans?, O. aegea. CRUSTACEA—*Calymene platys, Dalmania anchiops* and var. *armata, D. selenurus, D. aegeria, D. cornuta, D. macrops, D. adspectans, D. myrmecophorus, D. helena, D. calypso, D. pleione, D. erina, D. bifida, D. Boothii, Homalonotus Dekayi, Phacops bufo, P. rana, P. cristata, P. bombifrons, P. cacapona, Proetus Conradi, P. angustifrons, P. hesione, P. clarus, P. crassimarginatus, P. canaliculatus, P. Verneuili, P. Haldemani, P. Rowi, P. marginalis, P. macrocephalus, P. auriculatus, P. occidens, P. longicaudatus, Lichas armatus, L. grandis, Acidaspis* sp., *Beyrichia punctulifera, Leperditia cayuga, L. spinulifera, L. seneca.* ANNELIDA—*Spirorbis angulatus.* CRINOIDEA—*Edriocrinus pyriformis, Cheirocrinus clarus, Ancyocrinus bulbosus, A. spinosus, Platycrinus eriensis, P. clusceus, Poteriocrinus nassa, P. nycteus, C. diffusus, P. nereus, P. verticillus, P. indentus, Cyathocrinus bulbosus, Forbesiocrinus lobatus, F. nuntius, Rhodocrinus s.g. Acanthocrinus? nodulosus, A. gracilis, Rh. spinosus, Trematocrinus spinigerus, Actinocrinus nyssa, A. eucharis, A. praecursor, A. cauliculus, A. calypso, A. pocillum, A. s.g. Megistocrinus depressus, M. ontario, Cacabocrinus speciosus, C. Troosti, C. liratus, C. liratus* var. *multilira, C. glyptus,* and var. *intermedius, C. lamellosus, Myrtillocrinus? americanus, Haplocrinus clio, Nucleocrinus elegans, N. lucina,* and var. *N. Verneuili, Pentremites leda, P. calyce, P. Maia, P. Whitei, P. Lycorias, Eleutherocrinus Whitfieldi, Codaster pyramidatus.* BRACHIOPODA—*Zygospira* (new genus founded on *Atrypa modesta*), *Meristella* (new genus founded on *Atrypa quadricosta*), and *A. mesacostalis, Lingula ligea, L. paleformis, L. exilis, Discina alleghania, Crania Hamiltoniae, C. crenistriata, C. Leoni, Onthis lepidus, O. cyclas, O. penelope, O. leucosia, O. solitaria, Orthisina arctostriata, Or. alternata, Ambocoelia gregaria, Vitulina pustulosa, Spirifer venustus, Trematospira gibbosa, Rhynchospira nobilis, Rh. lepida, Atrypa pseudomarginalis, Merista Haskini, M. Barrisi, M. doris, M. multicosta, M. limitaris, M. quadricostata, M. mesacostalis.*

Professor Hall appends an amendment of the description of his genus Pholidops, and throws some doubts to the *Gonialites Patersoni* figured in the State Report, p. 99, belonging to the Hamilton shales, recent evidence indicating that it may be a Portage fossil. Eleven plates of figures are given.

In the January number of the 'American Journal of Science,' Professor A. Winchell enters the list in respect to the subject brought under discussion by Colonel Jewett's letter in November last, namely, the identification of the Cattskill Red Sandstone group with the Chemung. "No one who has recognized the carboniferous aspect of the fauna of the Marshall group of Michigan, with its equivalents in the West, can," he says, "feel any surprise at the announcement;" and he adds the following results of his own investigation during the past eighteen months:—"Species common to Michigan and Rockford, Indiana, 7; to Michigan and Burlington, Iowa, 7; to the three localities, 3; to Rockford and Missouri, 6; to Burlington and Ohio, 2; to Burlington and New York, 3; besides an almost universal identification establishing fully the equivalency of the Chemung, Marshall, Ohio, Rockford, Burlington, and Chanteau strata." "The evidences," he continues, "that these localities are all of Carboniferous age, are—first, the fact that of the 135 species now known from the yellow sandstones of Burlington, no less than 40 ascend into the base of the Burlington limestone, while 2 rise to the upper portion of it, and 1 recurs in the coal-measures; second, the fact that of the known species of this horizon at least 9 occur in the coal-measures or upper part of the Carboiferous limestone; while thirdly, multitudes of species are clearly representatives of European and American Carboniferous types."

The other geological articles in the January number, are:—"Exposition of the true nature of *Pleurodictyum problematicum*," and "On Mr. Hall's genus Leptocœlia," by Carl Rominger, M.D.; "On the Actæonidæ," by F. B. Meek; "On Tellurbismuth, from Dahlonega, Georgia," by D. M. Balch; "On Octahedral Galena, from Lebanon County, Pennsylvania," by Dr. Torrey.

The March number opens with an able article by Mr. T. Sterry Hunt, of the Canadian Survey, "Contributions to the Chemical and Geological History of Bitumens and of Pyroschists or Bituminous Shales." Some of the facts and deductions given in it have already appeared in Mr. Hunt's 'Notes on the History of Petroleum," printed in the 'Canadian Naturalist and Geologist' for July, 1861, and in the report of the Smithsonian Institution for 1862. Previous to the publication of these papers, Mr. Hunt had, in March, 1861, in his lecture before the Board of Arts, maintained that the source of the Petroleum of the West, was not as was generally thought. The May number we noticed at p. 276.

The interesting town of Manilla has been overthrown, almost in a moment, by an earthquake. Some accounts speak of the whole town being in ruins: others say that half the place has been destroyed. At all events, the Cathedral, the Royal Chapel, St. Domingo, St. Isabel, San Juan de Dios, the Palace, several schools, the military hospital, the buildings occupied by the Tribunal of Commerce, and indeed all the public buildings were razed to the ground; and even those buildings which remain are mostly so shaken that they must be pulled down. All the houses in Baracca fell. The Binonda, an ancient structure, was destroyed. The only church that has escaped entirely is San Augustin, which also withstood the tremendous shock of 1645. An architect's report, after a minute investigation of the peculiarities of the design and construction of this edifice, would be an interesting and instructive one. The Rodrigues property, left to the British nation, and where the British Consulate was, has been completely destroyed. About 1000 persons have been killed, and many thousands wounded. The survivors have mostly fled from the city, as many of the remaining buildings threaten a sudden fall, even though no repetition of earthquake should occur. The 3rd of June was the date of the catastrophe.

Professor Whitney, the State geologist of California, is reported to have found on the Sierra Nevada, at about 200 feet above the sea, the jaw of a rhinoceros.

REVIEWS.

The Mines of South Australia.

Observing the growing importance of the mining interest in South Australia, and the evident want of general and correct information respecting its mineral resources, Mr. J. B. Austen, of Adelaide, conceived the idea of making a tour of all the mines in that colony, and of publishing the result of his observations.

Up to the close of the past year, 1720 mining claims had been applied for, and of these, 1576 within the last three years. The large majority of these represent 80 acres of land for each claim, and when the claim is taken up, a rent of ten shillings per acre is paid to the Government under the present regulations; the leases being for 14 years, and renewable at the end of the term on payment of a fine. But, although so many claims have been applied for, the number of mines actually worked is very small in proportion, the explanation of which is, that every claim does not represent a separate lode or discovery of mineral, but that when a discovery is made by one party, others take out claims all round in the hope of finding something, and often without any knowledge of the locality at all on the part of such speculators.

Where speculations are so ready, it will create no surprise that as soon as the least surface-indications can be shown, the spot is termed a mine, and some assumed or honorary "captain" writes a glowing report of the wonderful discovery, which of course, it is asserted, will pay from the very first day that a pick is struck into the ground. The experience of South Australian mining does not warrant a belief in these confident assurances, and it does not follow that even rich superficial indications will result in the development of a valuable mine; and Mr. Austen suggests the propriety, in cases of mineral property intended to be sold, of sinking one or two shafts or cross-cuts to prove the existence at least of an ore-bearing lode going down to the depth of a few fathoms. It is certainly fair for all parties that some amount of work should be done to prove a mine before it is sold, for if one of great worth might be sold by a poor or ignorant man for a very small sum, so might a higher price be given for a worthless mine. Concise and instructive, and, as far as a stranger to the country can judge, correct and fair accounts are given of all the mines in actual work. These are the Kapunda, Karkulto, Burra-Burra, Princess Royal, Bon Accord, Broughton, Mount Remarkable, Spring Creek, Great Gladstone, Kanyaka, Mount Craig, Wirrawilka, Kirwan, Napoleon, Wheal Blinman, Davison's Claims, Wheal Butler, Mount Huro, Mount Rose, Apex Hill, Yadanamutana, Wheal Austen, Yelda, Pindilpena, Welcome, Oorooldana, Parabarana, Sir Dominutt, Daly, Wheal Frost, Mount Lyndhurst, Wheal Besley, Mochatoona, Wirryoota, Mount Stuart, Nuccaleena, The Two Brothers, Oratunga, Mooroo, Mount Chambers, Vesey's Claim, Mallee Hut Claim, Aroona, Welpena Pound, M'Conville's, Malone's Bremer, Preamimma, Kanmantoo, West Kanmantoo, Wheal Ellen, Monster Lode, Strathalbyn Montacute, Glen Osmond, Scott's Creek, Burritt, Gorge, Yattagolinga, Campbell's Creek, Falisker, North Rhine, Wallaroo, New Cornwall, Matta Matta, Kurilla, Duryea, Yelta, Moonta, Karkarilla, Wheal Stuart, Wheal Humby. After the accounts of the mines are descriptions of the smelting-works, mineral regulations, railways, and prices of labour and provisions are given. Altogether this must be a most useful book in the colony and out of it, and it would be well if the mines of our own country were noticed as fairly, in a similarly concise manner, by some of our able mineralogists.

SPHENOPTERIS FLAVICANS, Sternberg.

From Coal Shale, Forest of Dean ?

THE GEOLOGIST.

OCTOBER 1863.

FERNS IN COAL-SHALES.

BY THE EDITOR.

is very much to be regretted that amongst our rising geologists ᵋ have none who are turning, as far as we know, their attention votedly to fossil plants. There is a wide field open, and a most teresting one, for since the time of Lindley and Hutton, now sixd-twenty years ago, we have had no important British work on this anch of geology, and it cannot be supposed that the advance ide by recent botanists in that interval would not be applicable, d of the highest advantage to the study of fossil vegetable remains. 'e have quite enough shell-pickers and mammoth-hunters for a few devote their time and their energies to the ancient "flowers of the lds," if flowers there were in those dreary days which some of our *vants* picture when they tell us how the carboniferous vegetation xuriated in the warmest and densest of fogs, and the earth itself is a gigantic warming-pan for the plants that grew upon it.

The pretty fern-leaf we have figured came into our possession some ars ago very accidentally, so much so that we are not quite sure of en its locality, and it is now deposited in the National Collection. either in Lindley and Hutton, the figures in which are not exuisite examples of art, nor amongst the actual specimens in the ritish Museum cabinets, could we find anything with which it emed to accord. In Sternberg's 'Flora der Vorwelt' there apeared to be, in plate xxxviii. fig. 1, *a*, *b*, *c*, a fern presenting the ime configuration of leaflet and the like venation, and, without doubt, we think the species is the same, namely, *Sphenopteris flavicans* of Presl. Not finding this species recorded as a British one, we carefully drew it; but our engraver, not being a naturalist, has lost the character of the venation in endeavouring, to his mind, to improve the picturesqueness of the drawing. The Plate (XIX.) however gives a very good idea of the general form, while the two little outlines of the venation we have added make up for the trifling damage the engraver unwittingly committed.

The description given by Sternberg is,—

S. fronde bipinnata, pinnis alternis sessilibus multijugis, pinnulis alternis subsessilibus parallelis lineari-oblongis obtusis profunde pinnatifidis basi acutis, laciniis oblongis obtusissimis integerrimis, venis pinnatis simplicibus apice acuto libero ante marginem frondis evanescentibus, costis rachibusque convexis flexuosis.

S. flavicans, Presl.

In schisto lithantracum Bohemiæ ad Brzas, prope Radnitz. Color frondis uti videtur ampliæ griseo-flavescens vel flavescente-virescens. Figura 1*a* ectypum a figura 1*b* paululum differens exhibere videtur; differentia hæc inde exorta esse potest, quod in figura 1*a* frondis pars suprema, in 1*b* frondis inferior fere pars unius ejusdemque stirpis conservata esse videtur. In figura 1*c* pinnula aucta exhibetur.

It is deeply to be regretted that the many opportunities that are hourly occurring in this land of coal and iron are so thoroughly neglected, and that scarcely anywhere, except in the Manchester district, are any collections of coal-plants made. Mr. Binney has done more in this way than any one else; but necessarily, from his other and important business avocations, his scientific studies would be somewhat desultory.

It is a common practice now to speak of coal being formed of certain kinds of plants, whose remains have been found in the shales associated with the coal-seams; but surely much false reasoning may thus arise, and the difficulties of such a line of argument become painfully evident when palæontologists speak of the old coal-making forest-trees as growing like mangroves in the sea. In the shales and

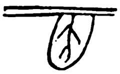


Fig. 1. Venation of British Specimen figured in Pl. XIX.

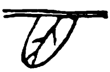


Fig. 2. Venation of Sternberg's specimen—*Sphenopteris flavicans*.

other strata associated with our coal-beds we have land-insects and sea-shells. We do not usually nowadays find the like associations in our tropical forests or in our own verdant dells. Surely it is rather more likely that the shales represent intermediate and different conditions happening between each formation of coal; and, in this case, the ferns imbedded in the shales may have belonged to quite another class of vegetation from that which formed the coal. Has anybody ever thought sufficiently how far the tender herbs of those days and myriads of fallen seeds might have been the chief sources of that bituminous product which makes England the first country in the world for civilization and wealth?

It is not our intention now to enter, however, into the matter of the formation of coal, nor of the nature and characters of the many beautiful vegetable forms which are imbedded in the intercalating strata. But we wish some one would earnestly take up the work.

CORRESPONDENCE.

The Older Parian in Trinidad.

DEAR SIR,—Permit me to observe, in reply to Mr. Lankester (whose letter appeared in your issue of July), that I am not the authority for the correlation of the Older Parian formation in South America and Trinidad, with the Neocomian of Europe. Indeed, from the references I gave I should have thought that Mr. Lankester would have had no great difficulty in finding out that the supposed age of the formation in question rested upon far better evidence than any I could produce. I had it only in my power to add a little to the evidence already accumulated on the subject, and to demonstrate it almost to a certainty that the rocks at Pointe-à-Pierre in Trinidad do belong to the same formation which it was the opinion of the Government Geological Survey that they did; that is, to the formation at Cumana, containing *Trigonia subcrenulata*. The opinion of the Government geologists was built upon evidence which was none the worse for being strengthened; and I had it in my power to do so.

But if the references given in the footnotes to my paper are not sufficient, I beg to refer Mr. Lankester to those appended to Mr. Wall's paper on the geology of Venezuela and Trinidad (Quart. Journn. Geol. Soc., vol. xvi. p. 465). Von Buch's work on the fossils collected by Humboldt contains much evidence relating to the age of the formation in South America.

When I transmitted my paper to you I was perfectly aware of Professor Huxley's views as regards "homotaxis;" and I have held opinions of a somewhat similar kind for some time previously to reading Professor Huxley's able address to the Geological Society. But in writing my paper on the Older Parian formation, my object was not to support or elucidate any theory which is yet quite new and unacknowledged by geologists at large; more especially when it did not make the least difference one way or the other as to the question upon which I was engaged. Whether the rocks in South America containing organic remains of types similar to the Neocomian of Europe were actually contemporaneous with the latter formation, or merely homotaxical and representative of it, was not the question I proposed to deal with. The general sequence of animal life is admittedly the same in either case; and whether the Neocomian in South America was or was not contemporaneous with the Neocomian in Europe, still it would have to be considered in comparative geology as Neocomian, at all events until some better nomenclature could be decided on. If Belemnites are not found above the Chalk, in Europe, it is probable they will not be found above the homotaxical representatives in South America of the Chalk.

I trust that this explanation will prove satisfactory to Mr. Lankester and to those of your readers who may take an interest in the matter.

I am, Sir, your obedient servant,

R. Lechmere Guppy.

Port of Spain, Trinidad, July 28th, 1863.

Former Higher Temperature of the Earth v. *Atmospheric Pressure.*

Sir,—The Rev. James Brodie, at the late British Association Meeting, stated that if at any time the earth had been subjected to a great increase of temperature, it necessarily implied an immense increase of pressure in the atmosphere. A slight increase, he said, would double the atmospheric pressure. Can you, Sir, inform me the grounds of the assertion, and the reasons why the atmospheric pressure would be augmented by the increase of internal heat? Perhaps Mr. Brodie would condescend to enlighten myself and others of your readers who may be in the same ignorance as myself upon this very interesting subject, if you, Sir, cannot or decline to give us the explanation. Yours respectfully,

Pulex.

Taunton, 4th September, 1863.

BRITISH ASSOCIATION MEETING AT NEWCASTLE.

The Section of Geology was under the Presidency of Mr. Warington W. Smyth.

President's Address.—If there is any one part of the British Islands where the very name of the place is naturally associated in our minds with a particular geological formation, it is the town of Newcastle as associated with coal; and, beyond a doubt, many of the present visitors to this cradle and centre of the coal trade will have made their journey hither with the expectation of not only hearing communications on various branches of geological science, but more especially of adding something to their knowledge of the carboniferous strata. We are to be favoured with several papers dealing with different portions of the subject, and it may be advisable that I should invite your attention to the state of our knowledge of the occurrence and history of the coal-measures generally, referring mainly to the phenomena which characterize that most valuable region in which we are assembled. I shall attempt, as it were, an overture giving a general outline of the carboniferous plot, and introducing a few notes to illustrate those passages which are most likely, in our successive ucts, to demand attention and concentrate our interest. The carboniferous system is commonly divided, for convenience' sake, and in accordance with the structure of most European coal-fields, into three principal divisions, viz. the carboniferous limestone, the millstone grit, and the coal-measures. I need here say nothing of the Devonian or Old Red Sandstone system, or of the still older rocks, which in the absence of the Devonian form the foundation of that great division of the geological scale with which we are engaged. The Carboniferous or Mountain limestone, the oldest group of strata for our consideration, might be hastily passed over, but for its presenting in this northern district a transitional type between Scotland and the south of England, no less important in its commercial aspect than interesting to the geologist, in the various inquiries which it suggests. Turn to the Mendips, to Wales, or to Derbyshire, and we find the carboniferous limestone constituted almost exclusively of actual limestone-strata, amounting to from 300 or 400 to above 1500 feet in thickness, and never exhibiting other than the smallest traces of beds of coal. But in Yorkshire a change sets in: the carboniferous action, if I may so term it, applies the thin end of the wedge, and small seams of coal of but little value are intercalated amongst the beds of limestone, and associated with a large proportion of shale and sandstone stratified with a remarkable regularity. Advancing northward, these seams increase in number and importance through the great moorland region which culminates in Cross Fell, the same strata rising from far beneath our feet as we stand here on the Lower Tyne, emerge to the daylight and compose the substance of the Pennine chain, which, with its lofty and heather-purpled undulations, forms the broad dividing ridge of Northern England. In the region of Weardale and Aldstone, where, in the becks and burns and in the great escarpment which towers above the valley of Eden, excellent exposures of the strata invite our study, the shales are often very similar to those of the coal-measures, though containing but few vegetable remains; the sandstones and grey beds frequently exhibit stems and fragments of plants familiar to us in the overlying strata, and the coal-seams are *crow-coal* or anthracite, resting in a bed of indurated siliceous silt or clay. Northward, however, of the great fault which runs nearly parallel to, but south of, the Newcastle and Carlisle railway, the coal-seams become, and, as it appears, suddenly, bituminous, and the lower division of the limestone admits more numerous intercalations of shale, sandstone, and coal; and when we follow it to the upper district of the Tyne and beyond the river Coquet, the violent folding and contortion to which the strata have been subjected bring into view new basins or fields of coal. The true position of these is far beneath our ordinary measures, and has been recognized as such in Scotland, where they attain a vast importance. In the Berwick district, which has been minutely described by Mr. Boyd, it would appear that about 400 fathoms of carboniferous limestone measures have been detailed below the Whin Sill or Basaltic bed and about 100 fathoms above it, including in all twelve seams of coal of from 2 to 4 feet each. Certain of these, the Scremersten seams, appear to be remarkable in having a limestone roof. For the details of another of these basins of the limestone coals, I may refer you to an excellent paper by my indefatigable friend Mr. Nicholas Wood, published, as is Mr. Boyd's paper, in the Transactions of the Institute of Mining Engineers. Let us pass from the upper beds of the limestone to the next overlying group of deposits. The Millstone Grit, or "farewell rock," as it is sometimes called by colliers, embraces a series of strata unproductive in coal, and in which conglomerates and coarse and siliceous grits often preponderate. With this rugged crown many of the Fell tops are capped; but before it bends downwards to pass under the first strata of the coal-measures, we may frequently find with it strata of shale and sandstone and fire-clay, roughly similar to those of the true measures, but presenting to a practised eye peculiarities of structure and colour. As we descend eastward from the higher ground of the moorlands, on the edge of which the first Brockwell seam of coal is traced, and as we find new and higher seams constantly succeeding, and the strata inclined regularly towards the sea, we pass into the midst of that tract which, extending from the river Coquet on the north to near the Tees on the south, for 50 miles in length, forms the great northern coal-field. The greatest thickness attained by this formation is probably not more than 2000 feet; but it would be vain for me, within a limited time, to offer you details of the strata,—a subject which has been amply treated by Mr. Buddle, Mr. Wood, Mr. T. Y. Hall, Mr. Greenwell, and others. Let it suffice to say that in this thickness, there exist, associated with shales of many varieties and with fine-grained sandstones, some fifty-seven beds of coal, from an inch thick upwards, comprising in all 75 feet of coal; but that what are considered the workable seams are twelve in number, giving an aggregate of about 50 feet of coal. The most famous of these seams, from above downwards, are the high main, the yard coal, the "Bensham," "five-quarter," "low main," "lower five-quarter," "Ruler or Hutton seam," the "Towneley or Beaumont," the "Busty bank," "three-quarters," and the "Brockwell." On the east the coal-measures are overlaid, in a line running from South Shields past Houghton-le-Spring to near Bishop Auckland, by the Permian series, represented by the magnesian limestone and the Lower Red sand, that unequal and water-bearing bed which forms the great obstacle to the sinking of shafts to the underlying coals. Prejudice, it is well known, even after the difference of these strata from the mountain limestone was proved, long contended that the coal would not be found continuous beneath the magnesian limestone; and it is still asserted that the seams have proved inferior when they pass beneath it, as shown especially by the failure, in certain tracts, of the Five-quarter and Hutton seams. But no sufficient reason is apparent why such deterioration is not rather to be ascribed to that variation in quality which all seams are found to undergo when followed over a large area, than to the soil influence of an unconformable upper formation. The variation here alluded to exercises an important bearing on the commercial relations of different parts of the field, and whilst the best "household coal"—bright, giving a black cinder, and free from ash—extends from the Tyne to the Wear and from the last river to Castle Eden, and occupies another area about Bishop Auckland, the steam-coal, more dense and yielding a white ash, characterizes the district beginning some five miles north of the Tyne, and the tender-coal, best suited for coking, is largely worked all along the line of the western outcrops from Ryton down to the outskirts of Raby Park. As regards the physical agencies which have impressed its present form on this great coalfield, I would remark that they appear to have acted with upheaval in a north and south direction, as evinced by the regular strike over a great length of country. This was accompanied or followed by transverse fractures resulting in several very pronounced lines of fault. Two of these, running respectively E.N.E. and E.S.E., are the whin or basaltic dykes named the Hett and the Cockfield dykes. Of the others, the most noticeable is the great fault called the Ninety-fathom dyke, which starting from the coast near Cullercoats, where it displaces the strata to that amount, ranges past Gosforth to Blaydon, and then entering on the more hilly ground may be traced westward to the New Red Sandstone of ighbourhood of Carlisle. Along this western part of its course its is so great, as to inlay, as it were, on its north side, in the midst of iestone district, a long strip of the coal-measures of the Newcastle nd thus to give rise to the collieries of Stublick, Midgeholme, Tindal tc. The coals and other strata of this field have sometimes been red with those of Belgium; but when we regard the decided east 'est troughing and folding, and the vast number of the seams are so noticeable in the latter, we may conclude more properly that i the peculiar and often similarly circumstanced coalfield of Somer- e that we have to seek for the direct continuation of the field of the untries. Let us now cast a brief glance on the theoretical side of bject. Upon the mode of origination of the limestone, the shale, and it, little difference of opinion is now entertained. That the coal itself en formed purely from vegetable matter can no longer be questioned. iew originally propounded by De Luc, that the vegetation now com- our coal-seams grew on the soil which actually forms the bed or " of the seam, has met with very general acceptance, notwithstand- e difficulty of adopting it in certain exceptional cases. That this mass of vegetation swelled over an area frequently subjected to de- on beneath the neighbouring waters admits of but little doubt. Such pothesis serves to explain not only the equable covering of the coals heir roofs of muddy or sandy matter, afterwards consolidated into and grit, and exhibiting to our gaze the remains of mullusca and which tenanted the waters of those depressions, but indicates also ode in which certain seams have been divided by partings almost ceptible in one place, but amounting to many feet in another. The nown Busty Bank seam of the western district, some 5 feet thick, ling a clay band of 11 inches, is thus divided in a distance of 2 or 3 by the increase of the parting to 18 feet, into the stone-coal and the quarter at Garesfield Colliery. A still more remarkable instance is ow Law seam at these works, 6 feet 3 inches thick, which, by the in- of a parting as it goes eastward, exhibits at Bowden Close Colliery, miles away, two seams divided by no less than 16 fathoms of ground, ich beds of sandstone or pert and their seams of coal have been in- ated. Such partings, when composed of shale, are often one mass gmarian impressions, and thus form no exception to the generally tant part which that fossil plays as the root of the chief plant of al; but when the partings consist of fine-grained clean sandstone, ng no trace of rootlets, I confess that the appearance of bright solid esting upon them seems to me to demand some other explanation. In- es of this kind observed in South Staffordshire and in the Whitehaven ries, induce me to think that the material must in some cases have introduced between the laminæ, and sometimes even diagonally rt them, subsequently to the solidification of the coaly matter. But are several curious phenomena as to which a doubt frequently arises, ier they are due to action during or after the formation of the coal, eductions of no small practical importance sometimes depend on the ion. Thus Mr. Hurst has given to the Institute a very exact account egularities, especially *swellies*, or narrow depressions in the Low Main which appears to have been formed prior to the deposition of the seams. On the other hand, Mr. Marcus Scott has excellently de- d a broad valley of denudation which was eroded in the coals of the shire field, and filled in with higher unproductive measures. Again, some of the slips and faults or troubles we may sometimes observe coal and ironstone beds so to change on approaching them, or to vary so much on opposite sides of them, that whilst in some few cases we may be led to suspect their contemporaneity with the beds themselves, there are many more which we cannot explain without supposing that the coal must at the time of the disruption have been moulded and squeezed in an almost plastic condition. In the determination of the plants of the coal much has been done, and the Newcastle names of Hutton and Witham have gained deserved honours in the cause. But much remains to be done by microscopic inquiry and by the observation in the pits of the plants which accompany particular seams. Göppert tells us of certain coals of Rhine-Prussia and Silesia that different seams are distinctly formed of different plants, sometimes Sigillaria and Lepidodendron, at others Coniferæ, and in many Stigmaria being chiefly prominent. May we not by degrees connect the peculiar and perhaps varying character of seams with the plants of which they are formed, and may we not advance to a much nearer perception of the true character of those wondrous primeval forests? And here I would remind you that whilst some of our guides in coal-geology incline to the opinion of a marine origin for their plants, thus bringing them into natural contact with the fishes and the probably marine shells often found in the shales, others insist on a terrestrial vegetation, and a third on that of lagoons or sea-swamps and bogs. The last few years have given more heavy arguments to those who insist on a lurid forest, however near to the water's level it may have been. We but recently knew that among these giant stems of Sigillaria the busy hum of flying insects and the merry chirp of the cricket were heard, that scorpions curled their ominous tails, that land shells crept slimily along, and that several genera and many species of reptiles either pursued their prey along the ground or climbed the trees, where hollow trunks have formed the casket to contain their remains. Here, then, is a goodly population to vivify the scene which only a few years ago was held to be almost wanting in all but vegetable life; and when we consider the accidents which have, amid the great decomposition of organic matter, preserved to us these remains, generally enclosed in ironstone nodules, we must feel confident that coming years will have many an additional fact to disclose. Of the whole range of the carboniferous formation, perhaps the most interesting in several respects is the lower division. Many years ago, Professor Phillips described the peculiar group of unquestionably marine shells occurring in the roof of the Halifax coals; and my friend Mr. Binney has traced throughout the length of Lancashire several seams which are thus characterized, and which are invariably below the thick seams of the main coal-field. I have been greatly interested in hunting up the same group,—the well-known *Aviculo-pecten papyraceus*, *Goniatites Listeri*, *Orthoceras*, and *Lingula* — in Derbyshire, North Staffordshire, and in North Wales. Again, they occur very similarly in South Wales at Merthyr and Nant-y-glo, and further west in the Kilkenny coal-field. I have devoted, at intervals, several days to the search for them in this coal-field, but hitherto unsuccessfully; and whilst their occurrence lends great force to the probability of the original unity and the subterranean connection of most of our coal-fields, their apparent absence in the Durham and Cumberland lower coals appears to indicate a peculiar difference in the conditions of deposition. The identification of distant seams, and of low as compared with high measures, appeared on this evidence very feasible; but Mr. Hull has not long since shown that caution is still needed, by announcing the occurrence of the same group in a higher seam in Lancashire. It is well known that the ironstone bands are among the most prolific sources of the objects of these studies, and I must, in conclusion, refer to the very interesting lists and parallels of fossils prepared by Mr. Salter for the two last numbers of the 'Iron Ores of Great Britain,' in the memoirs of the Geological Survey. The rich stores obtained by zealous collectors in South Wales, and yielded by the productive strata of the Potteries' coal-field, have been formed under his careful hands into a very valuable foundation, upon which I hope that we may soon see in course of erection a systematic and comparative natural history of the British coal-fields.

On Coke, Coal, and Coal Mining in Northumberland and Durham. By Messrs. Wood, J. Taylor, and J. Marley.—The Northern Institute of Mining Engineers will publish this paper, with several illustrations.

On the Fossil Teeth of Horse found in Red Clay at Stockton. By Mr. J. Hogg.—As many human bones had been dug up in the same field, it was supposed that a battle had been fought there, and that horses and riders had been interred together.

Magnesian Limestone of the County of Durham. By Messrs. Forster and J. Daglish.—As the magnesian limestone covered a considerable portion of the northern coal-field, its study was most interesting to those engaged in the mining operations of the district. This arose from its important bearing, not only in geological, but also in physical conditions. Of the latter, one of the most marked was the large quantity of water met with in shafts that had been sunk through the limestone for the purpose of winning the coal below. In all sinkings through magnesian limestone there were feeders of water, chiefly from gullets and fissures, and if the shaft were not drained the water rose to a point which generally remained constant. Although the line commenced at the sea-level, it neither continued in this plane nor followed the line of stratification nor the undulations of the surface, but rose almost uniformly with the surface as it passed inland. At Seaton Pit it is 226 feet from the surface, and at Hetton, 3½ miles directly west, it is 108 feet; and as the surface-level of the latter is 90 feet above that of the former, it follows that the line of saturation rises in this direction at the rate of 60 feet per mile. There is a curious anomaly in the case of North Seaton and Cambois Pits. The circumstances which favour the remarkable accumulation of water in the limestone, and the rapidity with which it is drained off into pits sunk through it, is due to several causes, some of which are peculiar to this formation, and perhaps to this district. They are—1st. The arrangement of the beds of stratification; 2nd. The contour of the country; 3rd. The permeability to water of this formation. The beds of stratification dip towards the sea at an angle somewhat more inclined than the surface of the ground, so that on this line of section the magnesian limestone crops out with a bold escarpment, about 3½ miles inland from the sea, forming one of the most pleasing features in the landscape of the south-east portion of Durham. An observer standing on the escarpment, and looking inland, would have an extended view over the wide expanse of flat country, which, owing to the softer character of the rocks of the coal-measures, always lies at its base, and ever running up into the limestone in deep bays or fiords, gives it the character of an ancient rugged coast-line. Seaward an entirely different aspect is presented, a series of undulating hills, intersected with many deeply-cut picturesque and beautiful ravines, which being low and sheltered are well wooded and clothed with a luxuriant foliage. The boldness of this escarpment is, no doubt, to a certain extent due to the soft nature of the "yellow sand" lying immediately below it; this sometimes reaching a thickness of 50 feet, extends over the flat base to a considerable extent beyond the limestone, and, being thoroughly pervious to water, forms a natural absorbent for all the drainage of the district round, which is further increased by the numerous before-mentioned bays jutting into the limestone. In addition to this, over the country extending from the outburst of the limestone to the sea, the large fissures already spoken of as intersecting in all directions the limestone form so many channels of communication between the surface and the bed of "yellow sand" down which the surface drainage, and even in some instances small streams, pass freely. It cannot therefore be wondered at that, when this formation is pierced by any shaft below the level of saturation, large volumes of water should be encountered; and, although this may for the time increase the engineering difficulties, and frequently add much to the cost of winning coal through the limestone, it has at the same time its brighter points of view, affording, as it does, an inexhaustible supply of pure and agreeable water to the inhabitants residing on its surface. The large towns of South Shields and Sunderland are entirely supplied by water pumped at extensive works at Cleadon, Fulwell, and Humbledon Hill. The town of Seaham Harbour is also similarly supplied. The water is hard for domestic purposes, but delightfully clear and refreshing to the taste." The general stratigraphical character of the magnesian limestone of the district was then entered upon. The next subject was the connection between the dislocation affecting the coal-measures and the magnesian limestone, this portion of the paper being illustrated by reference to a forty-feet upthrow fault, which passes through both the "Jane" and "Caroline" shafts of the Eppleton Hetton Colliery.

Skiddaw-Slate Fossils, and Hornblendic Greenstones and their Relations to the Metamorphic and Silurian Rocks of the County of Tyrone. By Professor Harkness.

New Coal-Plants from Nova Scotia. By Dr. Dawson.—One of the plants, *L. Acadianus*, belonged to the genus *Lepidophloios* of Sternberg: the other was an example of a type of *Lepidodendron*, very characteristic, in Nova Scotia, of the lower coal-measures associated with the lower carboniferous limestone. The author concluded that the original species of Sternberg, *L. laricinum*, was founded on the fragment of the bark of an old trunk, having the leaf-bases flattened, and hence described as scales. It was evidently, in short, closely allied to the specimen described. The genus *Ulodendron* was, he thought, identical with *Lepidophloios*, but apparently founded on specimens having the leaf-bases preserved, with the cone scars, but wanting vascular scars. It appeared to him that the generic names Ulodendron, Lomatophloios, Leptoxylum, Pachyphlœus, and Bothrodendron should be abolished in favour of Lepidophloios, unless indeed it should appear that any of these names had priority in date. The second plant described was the *Lepidodendron corrugatum*, which was one of the most abundant in the lower coal-measures of Nova Scotia and New Brunswick. The species was remarkable for its variability, and also for the dissimilar appearances of old stems and branches occasioned by the separation of the areoles in the growth of the bark, instead of the areoles themselves increasing in size, as in some other Lepidodendra.

Models illustrating the Contortions in Mica-Schist and Slate. By Mr. H. C. Sorby.—The models consisted simply of bands of india-rubber laid upon each other. In one, the alternate bands were covered with cloth, so as to deprive them of the elasticity possessed by pure india-rubber. The object of the models was to show how various phenomena in nature have probably been caused by lateral or superincumbent pressure. Pressing each end of a model with a little force, Mr. Sorby easily produced a series of curves and undulations, the suggestions of which were at once appreciated by the Section. In the case of the model with the alternate bands of varying flexure, the result was, of course, such as would be produced by contortions of alternating strata. Another effect was gained by having one end of a model held tightly and leaving the other free, so that, according to the pressure used and the curvature produced, the loose ends overlapped each other.

On a Deposit of Sulphur in Corfu. By Professor Ansted.—The island of Corfu and the other Ionian Islands, as well as the adjacent mainland of Greece, consist almost entirely of limestone. A chain of limestone mountains, ranging east and west, crosses the island of Corfu at its northern extremity, and as this is transverse to the general direction of the mountains on the mainland, and also to the geographical axis of the island, it may be regarded as a spur rather than a principal range. Crossing the pass of Pantaleone, a few miles beyond we come to the village of Spagus, the walls of which are built of gypsum. In the pieces of gypsum it is not rare to find yellow markings and patches of native sulphur. Leaving Spagus, a path leads by a deep ravine to a small quarry about a mile and a half to the north-west. Probably about a mile further beyond the ravine a small cutting presented a section about 8 or 10 feet high, and perhaps 20 feet in length. Here simple quarrying operations had been carried on. From the surface to the bottom of the quarry there were bands of gypsum nearly horizontal, and between them, somewhat irregularly, bands of native sulphur, varying in thickness from a quarter of an inch to an inch or more. There were also large masses of sulphur not continuous. All the gypsum gave forth a strong sulphurous odour when tapped with the hammer. From this little opening he was told that five tons of sulphur had been removed and used in the neighbourhood for the vines. He was informed that below these seams there was another thicker, at somewhat greater depth, and that for a distance equivalent to five English miles towards the coast to the north and west, a similar deposit was known.

Porphyritic Rock of Charnwood Forest. By Professor Ansted.—The part of England referred to is a small district in the county of Leicester, east of the various other developments of igneous rock in England. The object of this paper was to show that the rocks, consisting of syenites, granites, and others of the appearance and character generally regarded as igneous, were really of the same date as the slates with which they seem to alternate. The area concerned is only eight miles in length and not more than five miles across; but within that space it contains a singular variety of the rocks usually called igneous. For the sake of convenience the author called them porphyries, including all under that general name. They all contain nearly the same mineral composition. The slates are found disturbed by an antichinal axis, and are turned round at the southern extremity; but with that exception all dip in the same direction on both sides of the granites and syenites. There are also in many places very well marked alternations and passages by which the slates may be traced into granite. This perfect gradation is one of the geological characteristics of the district, and, combined with the extreme variety of rocks of the granitic kind, render the whole of Charnwood Forest typical in English geology. It is clear either that the slates were originally a continuous submarine deposit, of which certain parts have since become porphyries, or that the slates were formed from clay at successive intervals of time,—the time being long enough, and the change of level great enough, to admit of the conversion of clay into slate on each occasion, while each interval was also marked by the outpouring of igneous rock,—or else, that the slates were cracked in the plane of their bedding, and the granite thrust through without disturbing the dip.

These last two hypotheses are too little probable to require much consideration. On the whole, the author concludes that the theory of metamorphism is that which will ultimately commend itself to geologists.

The author disputed the propriety of attributing these slates and other rocks of Charnwood to the Cambrian period; all we knew was the fact of the great mass of them being clearly the result of some older condition of the earth. Professor Ansted concluded by pointing out that the existence of any fluid nucleus of the earth near the surface, or even within many hundred miles, is altogether contradicted by the latest physical investigations; that the existence of a few good instances of passage-beds from slate to granite is sufficient proof of the possibility of that metamorphosism of which there are so many other indications, and that the study of one small typical district like the one in question is of itself more instructive and useful to the geologist than larger illustrations, though these also must be obtained before he can arrive at any general conclusion.

THE ROCKS OF THE MALVERN HILLS. By Mr. H. E. Holl.—The author arrived at the following "conclusions:"—

1. That the metamorphic rocks of the Malverns are probably of Laurentian age. 2. That these Laurentian rocks were above the sea-level during the period of the deposition of the Cambrian system. 3. That previous to, or during the deposition of the Primoidal Zone, the range became depressed. 4. That subsequently to this the range was again elevated, and continued so until after the deposition of the Lower Llandovery rocks. 5. That the Upper Llandovery beds were deposited during a period of depression, which depression continued until after the deposition of the Middle Devonian series; that portion of the range which is between the Wind's Point and the Worcestershire Beacon having been the last to be depressed. 6. That subsequently to the Middle Devonian period the range again became elevated, and continued so during the deposition of the Upper Devonian beds, the carboniferous limestone and millstone grit. 7. That this was again followed by gradual depression, during which the coal-measures, the Permian system, the Trias and Lias, were deposited. 8. That the eruptions of trap-rock along the range of the Malverns belong to two distinct epochs, the one anterior, the other posterior to the deposition of the Upper Llandovery beds. 9. That the age of the faulting of the Upper Silurian and Devonian strata on the western flanks of the range, was after the close of the Middle Devonian period, and dependent on the upthrust of the crystalline rocks which took place about that time; but that the age of the great longitudinal fault, on the eastern side of the range, was subsequent to that of the Lias.

[Sir R. Murchison did not expect that he should live to see the day when these schists, and sandstones, and so forth, should be called Laurentian gneiss. He must protest, in the most energetic manner, against the application of this name to them.]

IRONSTONES IN THE WEST OF ENGLAND. By Mr. C. Moore.—The paper described in detail the equivalents of the Cleveland Hill ironstones in the West of England, commencing at Lyme Regis, and extending to Yeovil and Bath.

ON THE ORGANIC CONTENTS OF THE LEAD VEINS OF ALLENHEADS AND OTHER LEAD VEINS OF YORKSHIRE. By Mr. C. Moore.—The author thought he need scarcely remark to those who are acquainted with mining operations that the contents of mineral veins are often as varied in their character as they well can be, in general being highly mineralized and dense, at other times varying from a conglomeratic infilling to materials more nearly approaching the sands, marls, and clays of stratified deposits.

ɔse examination of the latter shows that at whatever depth they may ɔund they give evidences of their having been derived, some, probably, ı the denudation of older rocks which have been re-deposited with : organic contents in the then open fissures of the veins, others from ɪger deposits showing that the rocks in which the veins are found were . either the bottom of the ocean or within its influence. That the de- t in the veins was at times very slow is shown by some of the clays g composed of as thin laminæ as if they had been deposited in hori- al beds. On having the specimens of the material before one, nothing look more unpromising to the eye of a Palæontologist. The most ɾuine would scarcely expect that anything like an extensive fauna could .erived from them, and yet he had before him probably from 160 to 170 ıies derived from carboniferous limestone veins alone. The first step ɪeir discovery is to wash the vein-stuff, floating away as much as pos- ɜ of the finer material; in doing which from some of the mines you can- but be struck with the great beauty and variety of the tints that are luced, the water being coloured by the different specimens from the t delicate French white to the densest black. In the sediment remain- after the washing, the organic remains are to be sought for. So abun- t are they in some instances that half an ounce in weight has yielded nany as 156 specimens, whilst others still remain in the deposit. nerous though the organic remains may be, it is not to be expected ; they are to be found in every sample selected somewhat promiscuously n a mine. Those that are mineralized or crystallized may be at once aside as barren. Below are given the number of samples examined, those that are fossiliferous:—White Mines, Cumberland, seven samples, ınisms in two; Grassington Mines, Skipton, fifteen samples, organisms ix; Alston Moor, eleven samples, organisms in five; Weardale, twenty- ɜn samples, organisms in thirteen; from Allenheads, eight samples. se being much mineralized, organic remains were found in three samples r; but in six others that have been more recently sent and more care- y selected, organic remains have been found in every instance. The ıples referred to above weighed from a pound to about an ounce. The est depth at the Allenhead Mines he had yet traced organisms is 678 ., but there appears no reason whatever for supposing that they may be obtained from the lowest workings, provided favourable material examination can be obtained. He would now take the Alston Moor nes of Cumberland. In specimens from the Slaggy Burn, Copper sle, we have a deposit of the same mineralogical condition, and contain- precisely the same genera and species as those from Corrhaust, Wear- ɘ, and equally abundant. The same influences appear to have been at :k at these points depositing a similar material with precisely the same anisms, and we thus have in effect what, if they had been found in a ıtified bed, would be recognized as organic remains upon the same hori- . Returning again to the Yorkshire mines; in the Grassington Mines of pton, in No. 1, he found fragments of bone or fish-scale, and No. 4, which, ore being washed, looked like a yellow brown marl, was wholly composed encrinital stems. This came from 330 feet from the surface. But the st abundant organisms, and perhaps the most interesting of all, come m the New Rake Veins. A sample, weighing when washed only half ounce, is crowded with fossils. A very singular group of specimens urs here, which have been called *Conodonts* by Pander, who considered y belonged to fishes, and divided them into thirteen genera of fifty-six cies; but lately they have been examined by Dr. Harley, who, from ir microscopic structure, thinks they belong to crustacea. Those presenting the comb-like form of very minute fish jaws, he has called *astacoderma.* A remarkable form, figured in a diagram exhibited by the author, was surrounded by serrated edges, and by one or two ridges in the middle, looking in the enlarged form as much like a rat-trap as anything he could compare them to, had never before been observed. It is interesting to notice that hitherto these curious bodies have only been found in the Ludlow bone-bed and its foreign equivalents, but here we have them in the carboniferous limestone. They are associated with numerous minute spine-like bodies, which appear to have a structure allied to that of fishes. There are teeth of small fishes, and univalves of different species. From these facts it appears to the author clear that all the carboniferous limestone veins, as far as he had been able to examine them, have been within reach of the ocean, at periods which would be indicated by their organic contents, obtaining their materials at one time from the denudation of older deposits, at others from the precipitation into them of much younger ones. The latter he stated to be the case with those of the Mendip and South Wales, whilst in Yorkshire the presence of Silurian conodonts would appear to imply the former.

He had stated that identical organisms occur at certain depths at Alston Moor and Weardale, placing them probably on the same horizon. It might be a difficult matter for investigation, but he believed it possible, by a consideration of this question, that certain horizons in mines might be established, not so clearly, of course, as in stratified deposits, but such as might enable a mine-manager to know the position of veins relatively with mines in other neighbouring districts, and thus know whether he might, and at what distances, be passing into barren or paying ground. Further, he believed these investigations would assist to establish the fact that minerals are due, not to plutonic, but to the very opposite agency.

THE ORGANIC REMAINS OF THE NORTH STAFFORDSHIRE COALFIELD.—Mr. Mullins read a report of a committee on the distribution of the organic remains of the North Staffordshire coalfield. The report was a long and detailed description, and appended to it there were lists of fossils collected from sixty-eight distinct beds of coals and ironstones, or, including subordinate beds, upwards of a hundred. The total number of species was stated at from seventy-five to eighty, and of about thirty-five genera. In the majority of beds, both of coal and ironstone, the upper surface contains a substance resembling a bone, and the scales, teeth, and other parts of fish, which have, beyond all doubt, been subjected to the action of water. This line is often extended into the body of the ironstone, but in no instance has it been known to penetrate the body of the coal.

ON THE CHRONOLOGICAL VALUE OF THE LOWER TRIASSIC ROCKS OF DEVONSHIRE. By Mr. Wm. Pengelly, F.R.S.—The author stated that the red rocks of Devonshire were eminently detrital, consisting of conglomerates, sandstones, and marls, and belong to the Bunter or Lower Trias. They occupy the whole of the country east of a line from Torbay to Porlock, in West Somerset. The general dip is about 15½ degrees in the direction N. and 44½ degrees E. (true), so that, judging from this horizontal extension in this direction, their volume must be enormous. Having dwelt at some length on the proposition that the rate of sedimentation must be, on the whole, limited by that of the requisite previous denudation, he proceeded to show that the amount of deposited matter is not necessarily the *measure* of the denudation which has taken place, or of the time expended on it. Amongst other facts in this part of his paper, he noticed the occurrence of pebbles of Triassic *sandstone* in the Triassic *conglomerate*, of denudational inequalities in the superior surfaces of beds at ious levels in the same vertical section, and of certain peculiar phenoma connected with the structure known as "diagonal stratification;" or which he proceeded to show that the conglomerates and sandstone, every layer, afford evidence of their littoral origin, and of their having n deposited on a tidal strand undergoing slow subsidence; and conled with a description of two systems of dykes of Triassic sandstone, of which, having a north and south direction, invariably intersects other, which runs nearly east and west.

On the Causes of Earthquakes and Volcanic Eruptions. By Mr. A. Davies.—The theory of the author was that these phenomena, generly preceded by atmospheric alterations unusual in degree, were also nected with them, and, indeed, caused by them. He imagined that matter of volcanic eruptions, which, or part of which, might be the inior surface of the earth's crust rendered fluid by fusion, was constantly ssed against its solid parts by the repulsion of deeper-seated central t, and that this pressure was balanced by the weight of the external osphere, the equilibrium being destroyed by the rarefaction or greater sity of the air, combined with variations in the internal heat, and that s these phenomena are produced.

The Chairman, Professor Harkness, remarked that the writer did not appear to be re of the most recent observations of the highest authorities on the subject, and re a definite conclusion could be arrived at concerning the influences of atmoric pressure, it was necessary that a greater number of observations should be made had been made by Mr. Davies.

The Early Conditions of the Earth, by the Rev. Mr. Brodie, who ntained the following propositions:—1. The greater heat of the tempe- and polar regions, in the earlier eras, cannot be accounted for on the position that the distribution of land and water was different from that ch now exists. 2. The change which seems to have been produced on metamorphic rocks was not caused by heat from within acting upon m while they were covered with a mass of superincumbent strata. 3. t we have no conclusive evidence that the temperature of the central t of the globe is higher than that of the surface. 4. That there is no lence that the great mass of the earth has ever been in a fluid state. That all the phenomena hitherto observed may be satisfactorily acnted for, on the supposition that the earth was at some former time osed to great external heat. The general inference which he would uce from his observations was that in all speculations in regard to physical condition of the earth in former epochs, it should ever be t in mind that an increase of temperature implies an increase of atmoeric pressure, with all the effects on chemical combinations and animal vegetable development which such an increase would produce.

A Help to the Identification of Fossil Bivalve Shells. By Mr. ry Seeley.—Students well knew that genera were practically realities, as such the geologist and the zoologist had to do with them. Between ly groups intermediate forms could not be found. The question then se—How many genera are known? Their distinctive characters deded on the definition of a genus adopted. If it were merely a number nearly-related species, then the descriptive characters would include se in all forms; but if it existed independently of the species being damental to them, then the specific characters could not enter into the cription of the genus. Practically, the latter view, adopted in this er, reduced the description to a sixth of the shortest customary lengths, lst the distinction became clearer by pruning away much that was common to other types. But even these characters were often needlessly redundant, and several common to nearly allied groups might be cancelled. Having in this spirit examined an extensive series of lamellibranch shells he found, in most cases, the hinge-characters among the more important residua; and shortly afterwards, whilst determining some casts of fossils in which the hinge-teeth were the only generic characters seen, it occurred to him to write the teeth down in formulæ like those used for the teeth of mammalia. Subsequent re-examination of specimens showed that in a large majority of cases these hinge-formulæ were almost the only characters with which the student need be troubled.

On the Pennine Fault. By Mr. W. Bainbridge.—The Pennine fault in the Pennine chain, the backbone of England, commenced near Tindale Fell, in Cumberland, passed near Brough and Kirby Stephen, and near Kirby Lonsdale passed under the name of the Craven fault to the vale of the Wharfe, a distance of 130 miles. Professor Phillips had minutely described the Craven fault. The researches of Professor Sedgwick did not extend further north than Brough. The Craven and the Pennine faults were on a much grander scale than the Ninety Fathom Tynedale fault, for they had rent mountains asunder, and were, in fact, immense fractures or splits along a long line of stratification. The Pennine chain was elevated on an axis which is now represented by the line of fault, but the true axis would probably reach further westward, and in time past the chain would have been higher than it is now. The slope to the western sea might have been as extensive as that now existing to the German Ocean. The author traced the igneous rock for nearly twenty miles along the base of the carboniferous chain, showing it to be of varied form and elevation, spread out into flat spaces, heaped up into lumpish hills, and rising to the skies in majestic graceful cones. The greenstone passed into slate of differing hardness, and both were found indiscriminately along the line. There were no organic remains in either. The amorphous greenstone was a dull dark substance, often liable to decomposition, but often very compact. On the western side of Dufton Pike occurred beds of granite apparently in round or oval deposits, as also in the beck to the north, like that of Shap Fell. Smooth boulders of this granite and of basalt were dispersed along the flanks of the chain northward. The granite on the Pike, and further south, contained mica. There were also veins or dykes across the line of greywacke, as at Gale, near Melmerby, containing felspar and Talc. There was no appearance of volcanic craters. Various conjectures might be hazarded as to the manner in which this mass of igneous matter was ejected. The wonderful forms of Merton and Dufton Pike seemed to prove that they began and completed their full stature after the elevation of the chain, for as fabrics like these could not at any subsequent period have been submitted to any serious aqueous disturbance, they seemed to indicate separate volcanic rests. There was no evidence in any part of the line of any extreme violence of explosion, and these pikes would probably not have survived in their present integrity any such fits of power. Their sides and summits must have been broken, and their contents reduced to the chaos apparent in other portions of the line. The growth of cones would require longer periods of time than that of pikes. It might appear to some an extravagant idea that the pikes had been burning mountains with regular volcanic rents; but, like giant cones, they might, through a central channel, age after age, pour forth their masses of liquid matter, differing in kind, but all successively hardening and consolidating the growing mountains with one fiery garment laid on another, and that, further fastened by dykes and veins of interjected substances, as they appeared to

ɜ the bones of a large skeleton, they might stand firm in their un-
ted strength till the fires ceased to burn, and the cup was, for the
ne, filled up to and beyond the brim. Some connection between
nnine fault and the Ninety Fathom dyke had often been suggested.
yke was first seen at Cullercoats, on the Northumberland coast,
half a mile north from the mouth of the river Tyne, where its effect
ry conspicuous in throwing down the magnesian limestone, and the
ying strata, from 90 to 100 fathoms. As there was not a vestige of
ı the Pennine chain, its elevation and the crisis of the Pennine
must have occurred either before the deposition of the coal or after
ain had been denuded of coal already deposited. But at the Tyne-
ult, coal was thrown down from a considerable height. It could
, therefore, be doubted that coal once existed throughout the chain
he millstone grit, and was washed off during the partial submer-
of the chain. In that case it would follow that the Tynedale fault,
ing after the deposition of the magnesian limestone and before that
New Red Sandstone, was older than the Pennine fault; and that
ter fault, with all its volcanic consequences, might have occurred
the same geological epochs, but after the effects produced by the
ale fault. This denudation of coal would, of course, imply an in-
liate subsidence of the mountain-limestone system, during which
ıl of the chain, both north and south of its depression and burial
the line of the Tynedale fault, would be washed away. It did not
that this subsidence should be excessive. There appeared to be
evidence in the disturbed magnesian conglomerates near Brough,
ıe Pennine fault, which followed the final elevation of the chain,
ıve occurred after the dislocation of the magnesian limestone at
oats. The existence of the Ingleton coal, which may, from causes
ng on a limited tract, have escaped destruction, seemed to show
ıe Tynedale fault must have preceded the Pennine fault; but,
ll that had been said, there was abundant scope for further observa-
nd reasoning on this difficult subject.

CUMBERLAND COALFIELDS AND NEW RED SANDSTONE. By Mr.
ınn.—In volume viii. of the Transactions of the Mining Institute
wcastle is published a paper which the author had read on this
. The bearing of his former paper was to show that the New Red
one was traceable from St. Bees through the collieries of the whole
coast and up to the vicinity of the village of Aspatria, where some
ıkings have recently been made by the representatives of the late
n Harris in the New Red Sandstone, and short driftings have led
y into the main coalfield towards Bolton and the neighbouring
ıin limestone. At the Ellenborough colliery the explorations have
d to the town of Maryport in the ten-quarter seam at the depth
fathoms, and have there been suspended at troubled coal attended
ery great thickening of the band with downcast troubles. Very
he same circumstances have attended the working of the Crosby
r at the depth of 70 fathoms; a set of dykes and bad coal, about the
ourse as the margin of the Red Sandstone, terminating the profitable
g of the ten-quarter seam. To the northward of the above line of
ıtions and down to the Solway, no operations in search of coal have
ırried on, but sundry quarries have been worked, showing the Red
one to be lying in regular strata, with a westerly dip similar to the
easures. From the above facts he had been led to form the idea
e Red Sandstone is but the superior strata of the coalfield, and that
ghbouring coal-seams will be *found underneath;* and judging from

the flatness of the country around Silloth Harbour, he had assumed that the bottom of the basin will exist in that quarter, for appearances of a coal-outcrop exist in the neighbourhood of the Criffle mountains in Kircudbright. In pursuance of this theory he assumed that the coalfield of Canobie is similarly circumstanced, for the Red Sandstone there crops out contiguous to the pits, and the nature of the various seams of coal simulate closely upon those of Cumberland. Another corresponding fact attends the colliery of Kirkhouse, belonging to the Earl of Carlisle, although a portion of it also contains coals belonging to the limestone formation. He had compared the sandstone in the neighbourhood of Maryport with that upon Sir J. Graham's property at Netherby, and found that they were identical,—that is, the upper portion; the lower portion of the beds being of a much paler colour, and approximating towards the specimens of the ordinary coal sandstone. The deepest perforation which has yet been made in the New Red Sandstone was by Mr. Cockburn, papermaker, near Wetherall, who bored in search of water, but failed in obtaining a supply. In a letter in August, 1862, he said the hole is standing 600 feet from the surface, 50 feet of clay and 550 feet of red rock, which experiment shows that the rock is remarkably free from water, and that the sinkings would in all probability be free from those expensive operations incurred elsewhere. But the most convincing argument as to his theory had been furnished by the Aspatria Colliery, belonging to the representatives of the late Captain Harris, a plan of which, with its connection with the Red Sandstone, was exhibited, showing that sinking took place in the Red Sandstone with a drifting into the main coalfield; the belief of the managers was that their coal was thrown down and passed underneath the said sandstones; all around the village and down to the Solway exhibiting nothing but red rock. Since he first promulgated these opinions he had found that many persons in the district had come to the same conclusion, although certain geological objections have been started. However, he had resolved to submit the foregoing facts to be canvassed and determined by an association of gentlemen so well able to dispose of the subject, which is supposed to comprise one of the greatest fields of coal yet untouched, and which in future generations may uphold England's greatness,—one which may not have been considered in Sir W. Armstrong's able elucidation as to the duration of our northern coalfields.

On Gold in Wales. By Mr. T. A. Readwin.

Artificially-produced Quartzites.—Mr. A. Bryson exhibited specimens produced experimentally, the object of which was to prove, from the fact that cavities in quartz could not be filled up at a higher temperature than 94 degrees, that granite rock had not been formed at a high temperature.

An architect present favoured this theory. He had seen repeatedly distinct waterlines in granite, and they might be seen outside the Euston Square Station, London. There was reason to believe that certain granites were of an aqueous origin.

The Antiquity of Man. By Professor Phillips.—He said that one of the remarkable fruits of geological investigation was to invest almost every point of the earth's surface with a new interest. The small French village of St. Acheul had long been remarkable for the school of Jesuits established there; but antiquarians had discovered that it was near a burial-ground of great antiquity. In the course of excavation there were discovered the graves of people far more ancient than any known to have been buried there. Other memorials were also discovered, and on one he had obtained from the workmen he read the name of Constantius.

A stone coffin was found, and also an armlet, which had been placed on the arm of a buried person. When they looked in front of the great face of excavation and saw overhead the Jesuit College, the ancient cemetery, and the Roman and pre-Roman graves, the question arose, "What could be the antiquity of the sand and gravel deposit at the lower level?" In Sir Charles Lyell's recently-published volume the situation was fully described. Concerning the deposits there was no difference of opinion; they were to be reckoned among the later deposits of geological time, and in the lower parts of these deposits a great number of interesting implements had been obtained. He described the deposits in detail, stating that freshwater and land shells were found in gravels and sands, and an argillaceous deposit over them. For the freshwater and land shells in the gravel it was not necessary to appeal to the action of the seas, which however was seen in the lower part of the level. There were, in different levels, cases of great agitation of water, comparative agitation, and comparative tranquillity. They might imagine a lacustrine deposit, against which there would be the objection that it would not produce gravel in such a form, it being twisted about in all ways, and that there ought to have been found lying parallel to the surface of the lake a great number of lacustrine shells; such was not the case, and that explanation would not apply to the mixture of freshwater and land and amphibious shells. The more ordinary explanation was to suppose the action of a river which had changed its position, so that the flint-instruments found near the bottom might formerly have existed near the top. The arrangement of the sands was obviously of such a kind that they floated over the pebbles and covered all below. The whole question came finally to this, —Could they determine the age of the gravel beds? They could not escape the conviction that the flint-instruments were of the same age as the gravel beds. Upon the supposition of strata having been deposited by river action, the upper surface of the deposits would continually tend to become level, and would be so when the deposits were of an argillaceous nature. In this case the slope varied from 2½ to 1½ degrees. In order to account for the present condition of things, it would be necessary to suppose that the country had been disturbed, and that there had been an elevation affecting the valley of the Somme. On an examination of the locality, they would speedily arrive at the impression that it was requisite to remember that there was no period of geological history from which it was safe to exclude a movement of the earth's crust. The map of France showed the causes of the elevation. The rivers ran in parallel lines across the chalk, and it was impossible to separate the circumstance from the similar fact in this country where these phenomena had been discovered. As there was reason to think that the valley had been subject to upheaval, accepting the supposition, they would not be able to determine the question of age by the excavation of the river. If they followed the suggestion of Sir C. Lyell, and took their measure from Scandinavia, they might come to some determination as to time; but this was a case of a local disturbance of the earth's crust, affecting certain lines of country in a given direction, and apparently ceasing beyond that.

On the Drift Beds at Mundesley, Norfolk. By Professor Phillips.—His remarks went to confirm some views which were of the greatest importance in reasoning with regard to the antiquity of mankind, and at the same time suggesting a mode of consideration which he hoped could be followed up. The district on the coast of Norfolk, where the cliffs were formed of glacial, postglacial, and preglacial deposits, had become famous through the investigations of Mr. Taylor. Some thirty years ago in

Yorkshire, below the boulder clay, there was found a quantity of flint and chalk gravel, which contained the bones of elephants, horses, and other creatures. Soon afterwards a similar discovery was made in Norfolk. Having described these deposits, the Professor said he was inclined to think they must not venture to apply to this country any argument drawn from Scandinavia. Each country must be studied for itself, and it was better to take each class of glacial deposits separately. He thought it was possible to account for these deposits by the introduction of the tide at different levels, and that it was not at all necessary to suppose that the coast had been disturbed in order to account for the level of the marine shells. He was inclined to think that all those mammaliferous strata should be put together as the deposit of one period.

ON THE ALLUVIAL ACCUMULATIONS IN THE VALLEYS OF THE SOMME AND OUSE. By Mr. R. A. Godwin-Austen.

ON THE DISCOVERY OF ELEPHANT AND OTHER MAMMALIAN REMAINS IN OXFORDSHIRE. By Mr. G. E. Roberts.—A considerable number of elephant and other mammalian bones have recently been met with in a cutting upon a new line of railway passing through Thame, in Oxfordshire. They were taken from a coarse rubbly gravel, mixed with stiff clay, about 13 feet from the surface. The section gives a surface-clay, lightish-yellow in colour and with a sandy bottom, 11 feet in thickness, lying upon gravel, the average thickness of which is 2 feet 6 inches, and which passes downwards into a light coloured sand. About 10 feet down in the clay, a vase was found, of coarse earthenware, full of small bones, and just above the gravel another vase of coarse brown ware. The gravel extended linearly for 60 yards, and was slightly dome-shaped. Some of the bones have been submitted to Dr. Falconer, who has recognized *Elephas primigenius* of the Siberian type,—teeth and other remains rather abundant; *Elephas antiquus;* a large species of *Bos* (*primigenius?* or *priscus?*),—top of radius, tibia, and horn core; many bones and teeth of *Equus caballus fossilis*, including a finely-preserved tibia of great size and a portion of another still larger; and some good fragmentary specimens of the horns of *Cervus elaphus*.

ON THE HYDROGRAPHY OF THE ST. LAWRENCE AND THE GREAT LAKES. By Dr. Hulburt.—The effects of frosts and thaws during the Canadian winters are very remarkable on the rivers, smaller lakes, and bays of the great lakes in the valley of the St. Lawrence. One example may be given. In the winter of 1861 the writer very carefully examined those effects upon Burlington Bay, at the head of Lake Ontario. The ice at the time was about 15 inches thick. Frequent thaws occur during the winter, at all of which the ice expands with the rise of temperature. With the return of the cold the ice again contracts, but the part which has been shoved upon the shore remains stationary, and the ice opens or cracks in parts over deep water. During twenty-four hours the ice had expanded 6 feet over a distance of 2 miles, whilst it remained firm on the south side of the bay, carrying with it about 80 feet of a wharf, which broke at the centre, whilst some 80 feet nearer the shore remained firmly imbedded in the ice that had not yielded. Similar effects were produced in other places along the same shore. This expansion and contraction of the ice is sure to destroy all these bridges and wharves built upon piles and light spars in the lakes and rivers which freeze over; for the larger lakes remain open during the winter. The boulders of primitive rocks which thickly strew the valley of the St. Lawrence are found, on one shore of the smaller lakes and rivers, to have been carried by the action of the ice far away from the water; and whilst those boulders often occur so abundantly on one shore as to prevent the traveller landing, he is sure to find the other shore quite free from them.*

Report on the Chemical and Mineral Composition of the Granites and associated Rocks of Donegal. By a Committee, consisting of Mr. Scott, Sir R. Griffith, and Professor Haughton.—The first portion of the report contained a general description of the geological features of the county Donegal, with an account of the different facts observed by the members of the committee during their various tours in the county. It stated that in many particulars the non-granite rocks of the county Donegal resembled those which are described by Mr. Macfarlane as characterizing the Huronian series of Canada and its Norwegian equivalent the Tollemarken Quartz formation of Naumann, and the views put forward were supported by quotations from Mr. Macfarlane's papers in the 'Canadian Naturalist and Geologist' for 1862, from the Reports of the Geological Survey of Canada, and from Keilhau's 'Gæa Norwegica.' One of the points on which considerable stress was laid by the authors of the report was the occurrence of "a chalcedonic conglomerate, of which the cement is micaceous and the pebbles are mainly siliceous of the chalcedonic variety, but consist also of pieces of the mica-schist itself, and sometimes also of feldspar." This rock is an extremely characteristic feature of the north-east of the county Donegal, and may perhaps be found to be present in a corresponding position in Scotland, as it would appear that conglomerates of a similar nature have been observed by Sir R. Griffith at Anie, in the neighbourhood of Callander, and by Professor Haughton at the summit level of the Crinan canal. The igneous rocks, which are very abundant in the county, were found to be regularly interstratified with the grits seen in Limshowan, while in the south of the county rocks of a similar constitution were found to be intrusive. Analyses of both varieties were given in the Report. The coarse-grained varieties of these rocks were all termed by the authors syenites, as they class under the generic term syenites all rocks which consist mainly of a hornblendic mineral associated with a feldspar, and with a quartz or mica, or both. This term includes diorite and other rocks whose nomenclature seems at present to be not quite fixed, as the names are used in different senses by different authors. Limestone was found in considerable abundance; no fossils have been discovered in it, and it passes into crystalline marble in the neighbourhood of the granite. As to the granite itself, it contains the two feldspars orthoclase and oligoclase, with black mica, quartz, and almost universally small crystals of sphene. In some varieties of the rock it is so abundant as to induce the authors of the report to term it sphenic granite. This mineral has been long known to exist in the granite of parts of Scotland, and it is also found in that of Galway. Evidence was adduced to show the gneissose character of the granite when seen in the field, and its passage by insensible gradation into gneiss and mica-schist in a manner precisely similar to that described by Keilhau as having been observed by him in Norway. In addition to this fact, attention has been drawn to the stratified nature of the granite, and to the occurrence of gneiss and of limestone in several localities within its area. In such cases the limestone is extremely rich in minerals, and is generally accompanied by a peculiar rock, called by the authors "sphene rock," which consists of orthoclase, quartz, and pyroxene, with sphene in extreme abundance; and a quotation was made from the Canadian reports before referred to, to show that a similar connection of these rocks had been observed in Ca-

* See also for the subject, 'Geologist,' vol. i. p. 539 (1858).

nada. The report did not contain any statements relative to the age of the rocks of Donegal, but it expressed a hope that the labours of the Geological Survey of Ireland in Connaught and of the Survey of Scotland would shortly afford data on which sound reasoning as to the age of the Donegal rocks might be based. The chemical constitution of the granites, syenites, and the included minerals, was then discussed. Most of the analyses have already been brought before the Geological Society of London, and published in volume xviii. of the Quarterly Journal. In addition to these, two analyses of Scotch granites were given, one from Strontian and the other from Tobermory, which had been selected owing to their similarity to some of the Donegal granites. The report concluded with an important investigation into the mineralogical constitution of the granites, which was furnished by Professor Haughton. Only the results of the calculation were laid before the Association.

It will be seen from the paper which has been already printed (Quart. Journ. vol. xviii. p. 403), that there are four equations to determine four unknown quantities, namely, the quartz, orthoclase, oligoclase, and black mica, which are assumed to compose the granites in which they are actually present, and whose composition is taken exclusively from the analyses of specimens obtained in the district under examination. From the coefficients of the four equations, which may be at once reduced to three by elimination of the quartz, ten constants are obtained, by the use of which the percentages are at once found. The application of this method of calculation to the seventeen analyses of granite and granite rocks, which are given in the report, leads to results which are unexpected. Nine of the granites give negative values to some one or more of the unknown quantities, and therefore cannot consist of the four minerals above mentioned. The remaining eight give positive values, and therefore may consist of these minerals. On applying to these eight granites further tests furnished by equations relating to the different protoxide bases, it is found that not a single one satisfies all the conditions exactly; however, the degree of approximation between the calculated and observed percentages of the constituents is very close, as was shown by an example. From this result it follows that not a single granite of those which were examined can be represented by four minerals having the precise composition given in the report, although nearly one-half of them might be represented by minerals having the same oxygen ratios as those assumed. Hence the authors would conclude that, as has been suggested by many petrologists, it is unsafe to draw conclusions as to the mineralogical composition of a rock like granite from the analysis of minerals picked out of veins and other coarse-grained portions of the rock, and that it is *à fortiori* more unsafe to apply to the case of any granite analysis of foreign specimens of minerals, which have never been proved to exist in the district in which the granite occurs. The actual specimens which have been analysed are deposited in the museum of Trinity College, Dublin, and a duplicate series in that of the Royal Dublin Society. A catalogue of the mineral localities of Donegal was appended to the report. Upwards of sixty species have been observed.

Report of the Shetland Dredging Committee in its Geological Bearings. By Mr. J. Gwyn Jeffreys.—The paper had been previously read in the Zoological Section.

On the Origin of the Jointed Prismatic Structure in Basalts and other Igneous Rocks. By Professor James Thompson.—The Professor's belief was that shrinkage was the cause of fracture and columnar structure, and that a peculiar tension starting from a central line was the cause of the very curious joint-structure, which was nowhere better exhibited than at the Giant's Causeway.

On the Bivalved Entomostraca of the Carboniferous Strata of Great Britain and Ireland. By Professor Rupert Jones.

Fossil Fishes from the Permian Limestone. By Mr. J. W. Kirkby.—The object of the paper was to record the discovery of fish-remains in the Upper Magnesian limestone of the Permian formation, the discovery being of interest, especially on account of the remains having been found at a horizon considerably higher in the Permian series than any vertebrate remains had been previously known to occur. The fossils were first noticed in August, 1861, in a newly-opened quarry belonging to Sir Hedworth Williamson, at Fulwell, a mile and a half to the north of Sunderland. Most of them are found in one bed or zone of beds of limestone, there nevertheless being several instances of their occurrence both above and below. The same fish-bed appeared to extend considerably to the north-east, a portion of a small fish having been obtained from Marsden Bay. The fossils were almost invariably perfect individuals. Fully nine-tenths of the specimens found belonged to a single species of Palæoniscus. The remainder belonged probably to two, or probably to three, species of the same genus and to a species of Acrolepis. The Palæonisci were small, the largest being but little over 4 inches in length. The Acrolepis seemed to have attained a length of 12 inches. Associated with the fish-remains there occurred rarely fragments of plants. These, though imperfect, appeared to be referable to three species; one a Calamite, another a Caulerpa, and the third was a large reed-like form, whose generic relations were at present difficult to determine. These were the only fossils that had been met with along with the fish. These fish-bearing strata were 150 feet from the top of the upper limestone. The discovery carried the Permian vertebrate from the lower beds of the Durham series high into the upper, and near enough to the Trias to give to their occurrence perhaps more than usual interest.

Mr. Howse suggested that as the Palæoniscus was a freshwater fish, and the magnesian limestone not a freshwater formation, the plants had been drifted with the fish into the sea, and both deposited together in the limestone.

Swedish Fossils.—Mr. J. G. Jeffreys gave a list of the Upper Tertiary fossils of Uddewalla, in Sweden.

On the Upper Tertiary Strata of the Bohuslan District. By Dr. A. W. Malm.—This was another contribution from Sweden. It had been accompanied by a slab, which, unfortunately, excited the suspicions of the Customs' officers, who, suspecting perhaps the concealment of brandy or cigars, or concluding that the slab was rubbish, had broken it up and destroyed it.

The President, Mr. Warington Smyth, remarked that observation was now establishing, beyond the possibility of a doubt, that certain portions of the north of Europe were now being elevated at a slow, still, comparatively speaking, rapid rate above the level of the sea, and also that we had in our country, especially in Wales, most conclusive evidence that the land had been elevated to an enormous height within a comparatively recent period. Dr. Malm had shown that there had been almost magical transformation in Sweden; but nearer home we might find the same class of phenomena. He had now to call attention to a most extraordinary depression between Durham and the south of the Tyne. A paper to be read showed that at a recent period, comparatively speaking, there had been a channel of considerable depth between Durham and a point above the High Level Bridge. The subject was of much importance to the coal trade, and it had excited great interest among viewers and miners generally.

A WASH OR DRIFT THROUGH THE COALFIELDS OF DURHAM. By Messrs. N. Wood and E. F. Boyd.—The course of an ancient river, to which the paper related, differed from the courses of the Tyne and of the Wear. It passed almost in a direct line from Durham to the river Tyne at Newcastle. It was 93 feet below the present level of the Wear, and 140 feet below the level of the foundations of the High Level Bridge, which were 30 feet below the bottom of the river. Having, in the prosecution of their professional duties, had many opportunities of collecting information of the particulars of the thicknesses of the covering of gravel, sand, and clay spread over the surface of the coalfield of Durham more particularly, in various situations and under different circumstances, and having had frequent opportunities of observing the effect of the abrasion of the mineral strata of the districts, and especially of a particular wash or drift in the coalfield of Durham which has denuded a considerable portion of the coal-measures, the authors laid before the Association the results of their experience. Premising that such a wash or drift can be traced through the coalfield from the vicinity of the city of Durham to the river Tyne at Newcastle, traversing a portion of the valley of the Wear, passing Chester-le-Street, and following the valley of the river Team, and terminating at the river Tyne, their communication consisted of a plan of the district in question, and a series of sections showing the line of the wash and the depth to which it extends, with various other particulars. An examination of the different cross sections, particularly those nearest to the river Tyne, will encourage the idea that the deepest portion of the denudation was by the eastern side, and that the edges of the strata nearest to that side are more upright and abrupt. No trace of shells whatever has been found in any part of its course, nor of bones or animal remains. The pieces of shale which were observed entire and resting on edge against the eastern side, as if recently broken from their stratified bed, contained on examination the usual ferns and plants of the Carboniferous series; all the stones and pebbles in having their edges entirely removed and rendered smooth, particularly those of harder character, bore evidence of long exposure to the abrading influence of water in motion, and whenever the bottom on which the diluvium rests was exposed, there are unmistakable evidences that the water which carried the débris was in motion and of great power. At the sinking of the Ouston pit, the first solid strata met with after sinking through the 23½ fathoms of clay and sand was a strong freestone, the upper surface of which was furrowed with rough and scored outlines and polished, as may be noticed in the exposed bed of a mountain-torrent passing over a strong rock. The edges of the coal-seams adjoining the denudation, as the Hutton seam by Harbour House and Frankland, and the main coal-seam at Urpeth, were worn and rounded off in some instances where the upper portion of the seam having been tender had given way to the abrading action, whilst portions of that nearer the floor remained, the intervening parts being filled up with clay and boulders and broken pieces of coal. The contemplation of this remarkable deposit suggests to the authors considerations of the following character:—1. The extent and cause of opposition which the dislodged waters of the ocean met with in their progress to their ultimate sea-level. If the magnesian limestone hills of Boldon, Pensher, Houghton, Pittington, and Quarrington (superimposed over the coal-measures), formed as decided a barrier as they now present. 2. The quantity of débris with which they were charged, and the opportunity thus afforded them of depositing these by the action of gravitation, exercised during the above opposition met with, until the silting process was completed up to the level at which the waters of Tyne and Wear now run over its surface. 3. As prior to this silting process the waters which caused the denudation must have been in motion at a point at a depth of 140 feet below the present level of the ocean, is it unreasonable to suppose that the whole length of the valley in which it occurs was once at a higher level than that at which it now exists? 4. When the deep areas thus depressed and excavated were sufficiently silted up, the flow of waters, the produce of drainage and springs in higher grounds, would flow off at the easiest level to the sea by the present course of the rivers Tyne and Wear, the diversion in favour of the latter being possibly induced by the subsidence of so large a thickness of coal strata as occurs at Monkwearmouth, being here not less than 2500 feet in depth, and composed extensively of argillaceous shales, which are known to contract considerably in drying after being in a moist condition.

Permian Rocks of the North-west of England. By Sir Roderick Murchison.—The author described the Permian rocks as the newest palæozoic deposits forming a natural group, characterized by community of animal and vegetable forms in various parts of Europe; and until he proposed the term Permian, this group had no collective name. In the east of England there was no perceptible deposit that could be classed with the Permian. In the north-west, particularly at St. Bees' Head and in the valleys leading from the river Eden to the Pennine range, there was a remarkable display of rocks, sandstones, and conglomerates, which were linked indissolubly and conformably with the magnesian limestones. The lower portion of the deposit, over a very large portion of England, was formerly called the Lower Red Sandstone. All these deposits had been, in the first instance, admirably described by Professor Sedgwick, whose description had been the foundation of all our knowledge on this subject. His reason for proposing this simple name was that he found on the Continent the representatives of the formation spread over a country twice as large as France; and when the same community of character was found in this country, our geologists adopted the name. He had asserted that in Germany there was a great overlying sandstone superposed on the magnesian limestone which formed the upper part of the group, and he showed, in all sections that were typical, that this mass of sandstone went with the magnesian limestone, and was completely separated from the Triassic deposits which were named the New Red Sandstones. This conclusion was steadily contested by many German authorities, who did not like to part with any portion of their Bunter Sandstein or to accord any part of it to his Permian group. Amongst those who opposed this view was Dr. Geinitz, who had endeavoured to show that it was a dual deposit and not a triad deposit, and he now called it Dias. Against that he (Sir Roderick) had entered his protest. The labours of Mr. Binney, followed by those of Professor Harkness, had, confirmed by his own survey of the rocks, proved that in reality the west side of England offered the most complete confirmation that could be given of the *tripartite* arrangement of the Permian group, and completely fortified him in the opinion that the Germans were wrong and that he was right. A detailed examination of the rocks, which he had been looking at with Professor Harkness, had led him to the conviction that if you ascend any one of the little groups, particularly the Hilton group, from the vale of Eden, up to the great Pennine fault, you will find a succession of conglomerate beds overlying the enormous mass of the lower portion of this great group. The details had been explained by Professor Harkness, whose observaions he confirmed. He called attention to the value of them in reference to certain beds of plants which were absolutely Permian plants. Above the limestone and conglomerate came a series of clays or shales associated with the sandstone. They passed conformably, without any break whatever, into the Upper Sandstone. He was sure Mr. Binney would sustain all he had said in reference to this group being a great palæozoic Trias. He did not like the words Dias and Trias, because in England we had no Trias; there was no central member of the system; the name was given to that superior formation by a German geologist because the division was clear in his part of his country. It was not so, however, in other parts; and no general name ought to be given from the divisions of rocks happening in any one country. St. Bees' Head exhibited a small and most instructive portion of the roth-todte-liegende of the Germans, or the Lower Red Sandstone of English geologists. The conglomerates which were deposited unconformably on the summit, called sandstones in that country, were eroded in a most irregular manner, and the breccia entered into all the sinuosities, showing in that part a complete physical break between the coal, the sandstones, and the superjacent Permian rocks. This was an important point, because an eminent German geologist had endeavoured to class this roth-todte-liegende with the coal-deposit. St. Bees' Head was an instance of the total separation of the carboniferous formation and the beginning of a new series of things in these breccia, gravel and sand. Immediately upon this breccia, the representative of the yellow sandstones, which underlie the magnesian limestone to the west, comes clearly and unequivocally the magnesian limestone, filled with such fossils as would be found at Sunderland and along the Hartlepool coast. There they had, then, magnesian limestone distinctly resting on this lower breccia, and superposed and passing upwards, without the slightest break in the argillaceous beds, into the sandstones. He would say a word on a point of importance to gentlemen living in mining districts. In Germany this deposit would not have been known so well had there not existed under it a certain thin band called kupfer-schiefer, which, though thin, was in that part of Germany explored most pertinaciously. In this country the roth-todte-liegende afforded no mineral substance, and we had been hitherto unacquainted with the value of a deposit to which he would now call attention. It was the most important mineral deposit that had ever been discovered in the north-west of England, and it was enriching the people to an incredible extent. He referred to the hæmatite deposits in the cavities of the mountain-limestone. It had often been asked,—To what age are we to attribute this enormous infilling with this hæmatite ironstone? There were some who had attributed it to Tertiary periods. Professor Phillips was the first who made the suggestion that it was probably connected with the very series of deposits to which he now called attention. He had said that at the bottom of this series was this great accumulation of breccia. It was distinctly seen as forming the bottom parts of it in many parts of Furness. The hæmatite had been frequently worked out by old workmen from the cavities under the breccia. This discovery enriched his Permian group, and it showed that that period of the earth, so remarkable in Germany for the up-pouring of porphyry, and the great change which took place in the earth's condition after the formation of coal, enriched the Permian system by the formation of a deposit of the richest and most valuable mineral in the British Isles.

Mr. Kirkby said the Permian system was as entirely connected with the mountain-limestone and with the carboniferous system, as the Cambrian was with the Silurian.

ON A FOSSIL SALAMANDER. By Dr. Geinitz, of Dresden.—An inter-fossil had been found in the Lower Permian or Dyas of Dr. Gei- ı the neighbourhood of Braunan, north-east of Bohemia, by Dr. ıt. It was found some years ago in a slab of grey marl slate, be- ; to the Lower Roth-liegende, not to the Kupfer-schiefer. Captain ›n had proved the relation of this class of fossils with the living siren *tina*) of North Carolina, so that he was persuaded he had in the fossil and gigantic siren or salamander, whose dimensions exceeded those living species about ten times. There were preserved three and a rtebræ, with a part of the skin, and the name proposed was *Palæo- ternenti*. . . . .

SANDSTONE OF THE NORTH-EAST OF SCOTLAND. By Professor ess. . . . .

ROCK-SALT AT MIDDLESBROUGH. By Mr. John Marley.—The was a sketch of the discovery of rock-salt at Middlesbro'. Messrs. w and Vaughan, who have proved this salt, were the first to com- ironworks at Middlesbro' some twenty-three years ago; also, were t to make the practical application of the discovery of the Cleve- onstone fifteen years ago, and opened their Eston ironstone mines, Middlesbro', thirteen years ago, having since then vended about six ı tons of ironstone therefrom. In 1863 they have the honour of the ery of salt in that district. The requirement of fresh water by ı. Bolckow and Vaughan, in connection with their ironworks at esbro', being large, they commenced, about four years ago, to sink The shaft was carried to a depth of 180 feet; and owing to the ders being in connection with the flow of the tide in the river Tees, nsequently brackish, they were tubbed back with metal tubbing, hers being freshwater feeders were also tubbed back, but arranged luices so as to be available when required. The supply of fresh not being considered sufficient, a very large bore-hole was com- d, about a year ago, from the bottom of the shaft, at the depth under the direction of Mr. Homersham, C.E., of London, and, with ring machinery of Messrs. Mather and Platt, of the Salford Iron- Manchester, worked by steam and flat wire-rope, a bore of 18 diameter has been put down to the present extreme depth of 1306 In going through the Red Sandstone, the maximum rate attained 3 feet in thirteen hours' shift, *i, e.* 1 foot per hour; and even when is of 1100 feet deep, a rate of 3½ feet per thirteen hours, or 3 inches ur, has been attained. The details of the nature of the strata bored h is given in the sections, and belong to the Upper New Red Sand- r Trias formation, the same as the rock-salt deposits of Cheshire. ck-salt was first pierced at a depth of 1206 feet, and the bottom is t proved, but is already 100 feet into it. The quantity and quality brine has not yet been fully tested, but the author had received the ng analysis:—

Chloride of Sodium	96·63	per cent.
Sulphate of Lime	3·09	„
Sulphate of Magnesia	0·08	„
Sulphate of Soda	0·10	„
Silica	0·06	„
Oxide of Iron	trace	„
Moisture	0·04	„
	100·00	

tent or area of this deposit it is not yet possible to estimate. On the north we have, at Castle Eden Colliery, the coal-measures overlaid b the Permian; and at Oughton Colliery, nearer to the Tees, the Trias h been bored into some 500 feet; the Hutton coal-seam, at Castle Ed Colliery, being some 750 feet below the sea-level, and the salt at Mi dlesbro' about 1250 feet; on the south side of the Tees the Lower Li puts on and is capped by the Upper Lias and Oolitic strata—these stra dipping both to the south and north from the Tees. The following is a account of the strata sunk and bored through :—

No.		Fm.	ft.	in.
1.	Made ground (slag, chalk, etc.)	1	5	0
2.	Dry slime or river mud	1	2	0
3.	Sand with water	1	4	0
4.	Hard clay (dry)	1	4	0
5.	Red sand with a little water	0	1	0
6.	Loomy sand with a little water	0	3	0
7.	Hard clay (dry)	2	3	0
8.	Rock, mixed with clay and water	1	5	0
9.	Rock, mixed with clay (dry)	0	1	0
10.	Rock, mixed with gypsum (dry)	1	0	0
11.	Gypsum with water	0	2	0
12.	Red sandstone with small veins of gypsum and water	9	1	0
13.	Gypsum rock (dry)	1	0	0
14.	Brown shale with water	0	1	0
15.	Red sandstone	0	4	0
16.	Do. with small veins of gypsum and water	2	0	0
17.	Blue poststone with water at bottom	0	3	0
18.	Red sandstone with water	3	1	0
	Bottom of sinking	29	4	0
19.	Redstone	72	5	4
20.	Red and white sandstone	0	1	6
21.	Red sandstone	35	5	7
22.	Do. and clay	0	1	0
23.	Red sandstone	8	4	3
24.	Do. and clay	1	3	0
25.	Do.	11	0	5
26.	Strong clay	0	2	9
27.	Red sandstone and clay	0	1	6
28.	Do.	4	3	5
29.	Do. and clay	1	3	0
30.	Do. with a vein of blue rock 1¼ thick at 1005 feet	8	1	4
31.	Red and blue sandstone	0	1	5
32.	Red sandstone	1	0	0
33.	Do. and thin veins of gypsum	0	1	5
34.	Do. do.	6	3	8
35.	Red sandstone, blue clay, and gypsum	0	1	2
36.	Do. with veins of gypsum	14	3	3
37.	Gypsum	0	3	2
38.	White stone	0	0	8
39.	Limestone	0	2	8
40.	Blue rock	0	0	2
41.	Blue clay	0	0	2
42.	Hard blue and red rock	0	0	10
43.	White stone	0	2	7
44.	Dark red rock	0	1	2
45.	Dark red rock, rather salt	0	6	7
46.	Salt rock, rather dark (1)	2	0	7
47.	Do. very dark (2)	0	4	1

48. Salt rock, very light (3)	. . . .	0	8	6
49. Do. rather dark (4)	. . . .	4	3	4
50. Do. very light (5)	. . . .	7	1	6
51. Do. rather light (6)	. . . .	1	3	0
Total depth up to and with Saturday, 29th of August, 1863	. . . .	217	4	0

The six items = 100 feet of salt (but not yet through) equal to 1306 feet.

Marley thought it premature to speculate upon the beneficial effects ie discovery, or as to its bearing upon the possibility of there being under the Lias in Cleveland.

r. Pattinson, analytical chemist, said that the importance of the discovery of this -salt at Middlesbro' would be appreciated when it was stated that the Newcastle ict consumed annually 100,000 tons of salt, which was chiefly obtained from the hire district. The alkali manufactures of this country existed in two districts— e of Lancashire and the Tyne. The manufacturers of Lancashire had a great ad- age in the Cheshire salt being so near at hand; but this discovery at Middlesbro' d give the Tyne manufacturers a decided advantage. Another advantage would be gained. There was a large quantity of heat wasted at present: one-third of the was wasted in producing coke, and in the iron manufacture a large quantity of was wasted in the blast, puddling, and other furnaces; and great economy might fected by evaporating the brine, which he hoped would be pumped from this bed of -salt. It would be an excellent method of economizing the waste heat from coke- s, the loss of which had been so long lamented by every one anxious about the coal ie district.

N SOME REMAINS OF BOTHRIOLEPIS FROM THE UPPER DEVONIAN DSTONES OF ELGIN. By Mr. G. E. Roberts.—The genus was instituted 840 for the reception of fossil remains evidently belonging to a large idrodic Celocanth allied to the Asterolepis. Although the shape arrangement of the dorsal scutes of this great fish were tolerably well wn from the abundance of specimens collected in Russia and Scotland, plates covering the head have not hitherto been found, save in frag- its too insignificant for determination. The author had obtained, ing a recent visit to Scotland, some of the missing data. They con- ed of two large and nearly perfect casts of the cranial buckler from the er Devonian Sandstones of Newton, by Elgin, for the loan of which vas indebted to Dr. Taylor, of that town; three considerable portions he thick enamelled head-plates from the same locality, belonging to Elgin Museum; a cast of a portion of a hyoid bone from the collec- of the Rev. Dr. Gordon; three casts of opercular and mastoid bones n the yellow grits of Alves, and three portions of head-plates from the ie locality, preserved under slightly different conditions to the speci- is from the Newton zone, both lent by Mr. Smith, of Inverness. In 6, Dr. Malcomson, of Elgin, called attention to fish-remains in a cal- rous conglomerate discovered by the Rev. Dr. Gordon, of Binnie, assigned a stratigraphical position to them, which the recent labours Professor Harkness have verified. The author accompanied that gen- nan to the quarries which gave the deciding data, and he placed the y and yellow sandstone grit of Newton and Alves immediately beneath fossiliferous sandstones of Scat crag. Upon these latter beds lie the loptychius yielding sandstones of Bishop's Mill, covered in turn by bly beds and the famous sandstone of Lossiemouth, which contains Stagonolepis. The whole series he regarded as true Upper Devonian. er detailed description of the head, the author remarked that Bothriolepis had been presumed to be a congener of Asterolepis, and perhaps rightly so; but we knew too little of the family of Dendrodic Celacanths to justify us in regarding any one as a central type. From the investigation he had lately made into the fish-bearing sandstone of Elgin, he was convinced that enough material might be got together, with a moderate expenditure of time and trouble, to elucidate the true character, form, and proportions of Bothriolepis, so long an enigma in fossil ichnology. The studies of Professor Harkness in the physical history and relative position of this most interesting series of sedimentary deposits ought, and probably would, draw the attention of geologists in general to deposits which, though possessing local characters, were yet of world-wide value, as giving solutions to questions which rocks far distant had given rise to, and for which Continental geologists had long asked in vain.

On a New Starfish (Cribellites carbonarius) from the Mountain Limestone of Northumberland. By Mr. George Tate.—The paper commenced by noticing its association with carboniferous plants. Previously no species of Asteroidea had been recorded from this formation. The specimen exhibited, found by Mr. W. Wilson, of Shilbottle, was an impression of the upper surface only of the organism, in a yellow, fine-grained, micaceous sandstone, and, although imperfect, was doubtless a sea-star, and, as the first discovered in the formation, it deserved the attention of palæontologists. The following characters could be observed:—Rays five, rounded, lanceolate, five times as long as the disk, ridged in the centre, covered with longitudinal rows of reticulating tubercles; disk small and tuberculated. The disk was only ·3 of an inch in diameter, whilst the rays were 1·5 inch in length. The sandstone from which this sea-star was obtained was about 20 feet above the Shilbottle coal, and about 10 feet below the "18-foot limestone," which was the fifth limestone sill in the mountain limestone of Northumberland; it was, he estimated, about 600 feet below the base of the millstone grit, and, as the formation was about 3000 feet in thickness, it was in the upper part of thi series of beds. The paper proceeded:—"Besides the sand-star, there occur in this sandstone *Strophomena crenistria* and the remains of plants. This association is of some interest. Numerous marine organisms in the limestones and in shales connected with them, belonging to the mountain limestone of Northumberland, abundantly evidence the deposition of such beds under marine conditions; but rarely are marine organisms seen in the sandstones which form a large proportion of this formation in Northumberland. Another sandstone higher up in the series, appearing in a quarry, exhibits however, a similar association. This sandstone, which is 23 feet in thickness, has a thin layer, one foot thick, which is crowded with *Strophomena crenistria;* but, both in the beds above and those below it, there are many fragments of carboniferous plants of the genera Sigillaria, Lepidodendron, Calamites, Knorria, and the *Stigmaria ficoides*. These cases prove, the author thinks, that some of the sandstones of the mountain-limestone of Northumberland were deposited in shallow bays of the sea, in which marine organisms lived, and into which were drifted plants which grew during the carboniferous era. These facts, however, do not invalidate the conclusion that coal was formed of plants which grew on the places where coal-beds are now found, for even in the Northumberland mountain-limestone formation each coal-seam rests on an under clay, which was the muddy and probably swampy soil in which the carboniferous flora grew. Sometimes a limestone, with marine fossils, overlies a coal-seam; but we never find a limestone or calcareous bed with marine fossils lying below it." The paper then noticed other beds that showed changing conditions during the period of their deposition, and concluded with the remark that the facts appeared to show a change of conditions while the beds were in course of formation. At first the conditions were unquestionably marine, but, from some unknown cause, probably from a gradual alteration of level and an influx of freshwater, these conditions became estuarine, and probably even entirely freshwater.

THE WEARDALE IRON ORES. By Mr. Charles Attwood.—In Weardale, iron ores, occurring as they do under the two different forms of spathose or sparry carbonate and of hydrated peroxides, have certainly been all at first deposited as carbonates, and have passed into the state of oxides and of hydrates by the joint effects of atmospheric and of aqueous action. Examples of every stage of the transition present themselves in all directions, and there are also met with, from time to time, abundant proofs that, whilst the carbonates deposited are more or less rapidly passing into the hydrated condition, a fresh deposit of carbonates is continually going on in the mines in cavernous interstices, and on the roofs and sides of ancient workings, very much in the same way as stalactites and stalagmites are deposited. Upon one occasion he found protruding, for 5 or 6 inches, from a block of pure and large-grained sparry carbonate of iron, a rod of malleable iron, of about a quarter of an inch in diameter, of which the other end was firmly embedded to about the same depth in the block, which had just before been broken from a mass of it, which was incrusting the walls and roof of an ancient drift, but which block must have been formed within one or two centuries. The author then suggests the importance, in geological considerations, of the solvent power of water containing alkalis, and the resulting deposition of silica and siliceous minerals.

SECTION OF THE STRATA FROM HOWNES GILL TO CROSS FELL. By Mr. Sopwith.—At the last meeting of the British Association in this town it was proposed that a section should be made from sea to sea, crossing the coal- and lead-measures of Northumberland and Durham, the great Pennine fault, the Red Sandstones of Cumberland, the Skiddaw group of mountains, and the coalfields at Whitehaven. The late Mr. Buddle undertook the portion from the German Ocean to Hownes Gill, including the entire strata of the Durham coal-field; but it was uncompleted at the time of his death, and the section now exhibited was the only part which was executed. It is upwards of 30 feet in length, and represents in great detail the strata of more than twenty-eight miles of the lead-mining districts. Mr. Sopwith especially mentioned his obligations to Mr. Joseph Dickinson for the care and accuracy with which he made the several measurements on which this section is based.

ON THE NEANDERTHAL SKULL. By Professor W. King.—The author gave his reasons for believing it to belong to the Clydian period and to be specifically distinct from man. He contended that the Neanderthal man was living in the terminal division of the glacial or Clydian period. In concluding, he adverted to a question involved in the present subject, and on which a preconceived prejudice is generally entertained. Agassiz, Latham, and a few others, including Huxley, would have no hesitation in admitting that the genus *Homo* has been represented by more than the one species now living; but there is unquestionably prevailing a deep-rooted conviction that the psychical and speech endowments of *Homo sapiens* are generic, although there is nothing to warrant such a belief, and much to oppose it. For his part, he saw no reason to doubt that there have been species of the human genus in existence unpossessed of those gifts which so eminently place the existing races, but in different degrees, above the highest anthropoid apes. Why may there not have been a Pliocene or a Clydian species, possessed of no higher faculties than such as would enable it to erect a protecting shed, fashion a stone for special purposes, or store up food for winter; but, like the gorilla or chimpanzee, be devoid of speech, and equally as unconscious of the existence of a Godhead? Man's psychical endowments are visibly expressed in the prominent frontal and the elevated vertex of his cranium. But, considering that the Neanderthal skull is eminently simian in its great characters, he felt constrained to believe that the thoughts and desires which once dwelt within it had never soared beyond that of the brute. The Andamaner indisputably possesses the dimmest conceptions as to the existence of the Creator: his ideas on this subject, and of his own moral obligations, place him very little above animals of marked sagacity; nevertheless they are such as to specifically identify him with *Homo sapiens*. Furthermore, the strictly human conformation of his brain-case bears out the collocation. Psychical gifts of a lower grade than those characterizing the Andamaners cannot be conceived to exist; they stand next to brute benightedness. Applying the above argument to the Neanderthal skull, and considering its close resemblance to that of the chimpanzee, and, moreover, knowing that the simian peculiarities are unimprovable—incapable of moral and theositic conceptions—the author saw no reason to believe otherwise than that similar darkness characterized the beings whom he did not hesitate to call *Homo Neanderthalensis*.

Fish-Remains in the Coal-Measures of Northumberland and Durham. By Messrs. T. Atthey and W. J. Kirkby.—Notwithstanding the great attention that has been paid to the vegetable fossils of this coal-field, very little is known of the fossil animals associated with them. In this respect the palæontology of the Durham and Northumberland coal-measures has been neglected, compared with what has has been done in several other coal-fields; for in the coal-measures of Yorkshire, Lancashire, Staffordshire, etc., these fossils have not only been carefully collected, but to some extent described, in the memoirs of Messrs. Hibbert, Binney, and Denny. The highest horizon at which the authors have observed fish-remains in the coal-measures of this district is apparently situate not many fathoms from their summit, or, to speak more precisely, from the base of the Lower Red Sandstone. The fossils referred to are found in some dark grey shales with nodular bands of ironstone, and in overlying beds of black and highly-carbonaceous shale or "blackstone." These beds are exposed on the north bank of the Wear opposite to Claxheugh, where they are brought up by an upcast fault to the east that crosses the river a little to the west of their outcrop. From the "blackstone," which apparently forms a very thin bed, there have been obtained scattered ganoid scales of small size, which evidently belong to species of Palæoniscus or Amblypterus. With them have also occurred a small maxillary and some other detached bones, which, so far as size is concerned, may belong to the same fish or fishes as the scales. These remains do not pass down into the underlying shale, but in place of them we there find large quantities of a small suboval or orbicular shell, which in the shale itself is pressed flat, but in the ironstone is flatly conical or patelliform. This fossil does not attain more than one-eighth of an inch in length, being generally less, is extremely thin, shows several coarse concentric wrinkles or plaits, and has an apex or umbo placed away from the centre. In specimens from the shale the umbo is not symmetrically placed. Specimens of this shell in the possession of Mr. Vint, from a lost locality, were shown to Professor Phillips more than twenty years ago, and referred by him to Ancylus. On rediscovering the fossil this year, the authors thought it an Estheria, but it is not considered by Professor Rupert Jones and Mr. T. Davidson be a Discina. In the shale it is always more or less scattered, but in ie ironstone it is so abundant in certain zones as to cover the whole of ie surface. Associated with this fossil, both in the shale and the iron-one, are specimens of *Beyrichia arcuata*, and in the ironstone alone a w obscure vegetable remains.

About 100 fathoms below the horizon of the preceding fossils another me of fish-remains occurs, and in the intermediate space more than one ind of Anthracosia and Anthracomya. The stratum that chiefly yielded ie fish-remains was passed through in sinking the Ryhope Colliery, near underland, and it consists of highly-carbonaceous black shale with inter-lations of coal, or, as the miners term it, "blackstone and coal-pipes ixed." Immediately over it is a 3-inch seam of splint-coal. From this ed the authors have taken the finely-enamelled scales of *Megalichthys Hibberti*, and others usually referred to Holoptychius, as well as such as ridently belong to species of Palæoniscus or Amblypterus; also sauroid eth of various sizes, the larger of which appear to belong to Megalichthys Rhizodus, and the teeth of *Diplodus gibbosus*. Along with these oc-urred various detached bones and coprolites; and on one horizon great umbers of Anthracomya were associated, and with them two species of ntomostraca,—*Cytheropsis Scotoburdigalensis* and a form yet undescribed. emains of plants, too, were not uncommon in this bed. Immediately rerlying the splint-coal is another stratum of black shale, 4 feet 2 inches uck, and this is overlaid by grey shale to the thickness of 36 feet. In iese beds the remains of fish were also found rarely, and with them, to-ards their base, were also met with specimens of *Lingula mytiloides* Syn. *Credneri*), examples of which we believe we also got from the black-one underlying the splint-coal.

The next horizon at which the remains of fish have been noticed is about 20 fathoms below the one just mentioned, in a thin bed of black shale or stone" that rests on the top of the Low Main Coal, at Newsham, about) miles north-east of Newcastle. The remains would appear to be far iore abundant on this horizon than on any hitherto discovered; and there is been obtained from the black shale that marks it, one of the finest ries of carboniferous fish-remains that perhaps exist in the north of ngland. These fossils consist of scales, spines, jaws, teeth, and bones, ie most important of which we notice below. Amongst the most in-resting are some large spines of Placoideans. The most common of these the *Gyracanthus tuberculatus*, of Agassiz. Perfect examples of this pine measure 15½ inches in length and 6½ inches in circumference. It is notable feature in them that they are nearly always much worn at the oint, as though they had been subjected to considerable wear and tear. t should also be observed that all these spines are a little out of true ymmetry; that is, they are slightly bent to one side. The lateral deflec-ion, moreover, is not always in one direction in different spines, but some-imes to the right and sometimes to the left. It has hence been suggested y Mr. Albany Hancock that the spines may not have been dorsal ones, s usually supposed, but paired spines, that were probably placed in front f the pectoral fins. Specimens of another spine have occurred, somewhat esembling *G. tuberculosus*, but differing from that species in having the oncave border denticulated and bounded on each side by a plain or un-uberculated area, as well as in being of smaller size. The authors have lso found specimens of a large spine that appears to be identical with the G. *formosus* of Agassiz. Also examples of an Orthacanthus, about 12 inches long, and of a Pleurocanthus, 9 inches in length, and of another that seems referable to Leptacanthus. Besides these, there have been found some small spines that are smooth and slightly arched; they appear to belong to two species. Among the scales are, of course, those of *Megalichthys Hibberti*. They occur either isolated or in patches. Sometimes they are associated with the enamelled plates that cover the head of this fish, including the maxillary bones showing the teeth. Isolated scales of great size, belonging to a large Holoptychius, are not uncommon, as well as others that seem to belong to a smaller species of the same genus. There are also numerous small ganoid scales, in some cases with sculptured surfaces and serrated margins; some of them belong to a species of Platysomus, and others to Palæoniscus or Amblypterus, or possibly Eurynotus.

In some parts of the "blackstone" large quantities of small thorny tubercles are met with, which have evidently formed part of the dermal armature of a Placoidean, and from the way in which they are associated with the spines of *Gyracanthus tuberculosus*, they not unlikely belong to that fish.

A great number of maxillary bones, most of them with teeth, are among the fossils found at Newsham. Some of them, as we have already mentioned, belong to Megalichthys; others, as large in size, have been referred to Holoptychius and Rhizodus. All these maxillaries are armed with sharp-pointed, conical teeth, which are not easily distinguishable from each other when found detached. A fragment of another large maxillary, with the external surface irregularly and deeply pitted, and with large lancet-shaped teeth, has been found. Numerous smaller jaws, varying from 2 inches to ½ an inch in length, occur, and among them differences are to be observed, both in the character and arrangement of the teeth, that appear to indicate the presence of several distinct forms. One of these differs so strikingly from the others in its cylindrical, bluntly-pointed teeth, as to suggest the probability of it belonging to a reptile rather than a fish. Besides detached teeth of the maxillaries noticed in the preceding paragraph, the authors have also met with teeth belonging to Placoideans. Among these are two species of Ctenoptychius, which we doubtfully refer to *C. pectinatus* and *C. denticulatus*. *Diplodus gibbosus* also is not a rare form; and in one instance these teeth have been found connected with the bony plates to which they were affixed. Some very beautiful palatal teeth of Ctenodus and Ceratodus have also occurred, as well as others that seem to belong to Psammodus. Of more common occurrence than any of the foregoing fossils are various detached bones. Many of these are evidently cephalic bones, and such as belong to the thoracic arch. Vertebræ, too, are not uncommon, some of them being large and apparently referable to a fish the size of *Gyracanthus tuberculatus*, to which they probably belong. There is also repeatedly found in conjunction with the latter spine a large triangular bone, which appears to have been originally articulated.

Having now mentioned the various fragmentary remains of fish that we have found in the Newsham blackstone, we may add that the only fossils of the same class which have occurred in that deposit in a more perfect condition is a nearly complete example of a Platysomus, and another of a fish which we identify with Cœlacanthus. Both examples are small, the former being 3 inches long and the latter 4½ inches. Associated with these remains are large quantities of coprolitic matter; also large irregular masses of a substance showing a roe-like structure, that may possibly represent spawn or ova of some kind. The vegetable fossils that occur in the same bed are *Lepidodendron elegans*, *L. Sternbergii*, *Lepidostrobus* sp., *Calamites nodosus*, *Bothrodendron punctatum*, *Sternbergia approximata*, *Megaphyton* sp.

STRICKLANDIA ACUMINATA.

Mrs. Strickland del.

[The fossils we have noticed above have been derived chiefly from the wsham pit; they have also been collected, to some extent, from the oining collieries of Cramlington, and they have been noticed in a lately ık pit at Prestwick. At all these places the fossils are only found in thin bed of black shale that lies immediately over the Low Main Coal.

NOTES AND QUERIES.

STRICKLANDIA ACUMINATA.—The *Stricklandia acuminata* was originally ıred in pl. 2, fig. 2, of the 'Geology of Cheltenham,' by Sir R. I. Murson, H. E. Strickland, and Professor Buckman; and there is also a odcut from Professor Buckman's specimen on the title-page of the emoir of H. E. Strickland,' and at page 167 of the Memoir, by Sir Jardine, Bart. The accompanying woodcut (Plate XX.) is from a speci- n which was obtained by Mr. H. Strickland from Mr. Dewberry, Chelten- n, and being a much more perfect specimen, it is thought worthy of a th illustration.

The quarrymen found the fossil at Sevenhampton, and Professor Buckn's specimen most probably came from the same quarry, as the quarryn said they found it in the Stonesfield slate-bed.

The leaf is imbedded in a hard sandy stone, and closely resembles the l of stone called "Stonesfield Slate" at Stonesfield, which at Sevennpton is at the base of the Great Oolite.

The leaf in form is very nearly identical with that of the existing *Salisia*, the similarity of the two leaves striking any one at once when they compared together.

BRITISH FOSSIL MAMMALIA AND FLINT IMPLEMENTS.—In the August nber of the 'Geologist' you ask for any information concerning British il mammalia not hitherto recorded. I send, therefore, the subjoined . All the specimens have been obtained from the Pleistocene deposits Fisherton, Salisbury, since the publication of Mr. Prestwich's paper in 5:—

Felis spelæa. Portion of lower jaw, with last molar *in situ*.
Hyæna spelæa. Nearly entire half of lower jaw, with all the teeth.
Canis vulpes. Portion of lower jaw, with teeth and portion of humerus.
Sus scrofa? Os calcis, only bone yet found.
Equus caballus. Both bones and teeth very plentiful.
Equus fossilis. Both upper and lower molar teeth of young individuals.
Bos primigenius. Bones and portion of horn case.
Bison priscus. Metatarsal bone.
Bison minor. Both metacarpal and metatarsal bones, not scarce.
Cervus Guettardi, or young of *Cervus tarandus*. Portion of shed ant- and bones.
Lepus timidus. Fragment of femur.
Lemmus Grœnlandicus? Teeth, jaws, and bones of several individuals. The portions of skull are too fragmentary to admit of a satisfactory conıson with the recent skeleton. Those portions which have been comed seem identical with the Orsinyak, or Greenland Lemming, in the tish Museum.
Spermophilus. Undetermined species. Teeth, jaws, and bones of many ividuals.

Although you ask for no information with regard to birds, it may be interesting to some of your readers to know that fragments of two specimens of such fragile things as birds' eggs have been obtained from the same deposits: one, in point of size and thickness of shell, would correspond, if entire, to that of a goose; the other to that of a moor-hen.

I also wish to place upon record the finding of a very perfect and characteristic flint-implement in the "higher level gravel" of Fisherton, on Monday last. It is pretty evenly stained of a pale ochreous yellow, and bears evidence of having had some rough knocks from its travelling companions. This is the first example found, after a patient search by myself and others of nearly five years. Surely, after this, brother-geologists need never despair of finding flint-implements, although, like myself, they may be often heartily tired of bootless expeditions.—Yours very truly, H. P. BLACKMORE, M.D.

Salisbury, September **17*th***, **1863.**

[We have received a drawing of the implement.—ED. GEOL.]

MAMMALIAN REMAINS IN RUSSIA.—The following are translated notes from Georgi's Hist. Nat. Russia, vol. iii.:—I. Decayed human bones, found in the graves of former settlers, together with metallic vessels, also with remains of burnt corpses; for instance, on the Yenisei, near Krasnojarsk, in Dauria; on the Ingoda; in the Ural and Kolywan mountains, in the mines of the ancients. Dried human bones, partially petrified, are found in lime- and chalk-pits near some river-banks in Podolia (Guetard); on the Swiaja of the Volga, on the brook Birjutsch, in clay (Lep.); on the Ik of the Kama, in sandy mountain-green.

Exhumed elephant-bones, *R. momotowa* (Kosti), mammoths' bones, skulls, jawbones, fangs, dorsal vertebræ, shin- and hip-bones, have been found in Russia, and especially in Siberia, for ages; and they were considered as the bones of a monstrous kind of animal, living under the earth and dying by contact with the air, and which very likely might have been the Behemoth of Job. The Russian academician, M. Du Vernoi, showed first that these bones belonged to elephants. When, in accordance with the order of Peter the Great, in 1722, all fossil and other curiosities were sent to the Imperial Museum of St. Petersburg, everybody considered these bones to be curious; and examples were thus brought there, together with other fossil bones, from many districts of Russia, in such abundance that they speedily filled the extensive vaults of the museum. In the greater part of the Siberian, and in some of the Russian rivers, they are washed out from their loosened clay, marl, lime, and sand, and earth of the shores. They are more or less efflorescent, soft, partly earthy,—some of them falling to pieces,—greyish, whitish, bluish; and some hard, and of a fresh appearance; and those are especially well preserved which occur in the Arctic swamps (*tundra*). For the most part these bones were found scattered singly, but sometimes also there were many together, although but very seldom whole carcasses occur. The museum now receives them but very sparingly, as they are less cared for.

II. On the bones, and places where they were found. 1. In Russia. Many elephant-bones, on the right bank of the Don, near Kostizi; on the Volga, near Kusmodimjarsk; in the chasms near Nischnii Nowogorod; on the Swiaja of the Volga, on the bank of the brook Birjutsch (Lep.; Pall.); on the mouth of the Swiaja; on the bank of the great Irgis, on the left of the Volga. An elephant molar tooth on the shore of the White Sea, also on the Dwina. Elephant-bones, in Permia, on the bank of the Babka; the Sylwa, near the foundry of Jugewskoi Sawod; one 9 feet long; on the Meschowaja Utka of the Tschussowaja, near Wisimo Utkinskoi Sawod, they have been discovered in an argillaceous bed in digging for ; on the Ik of the Kama; on the bank of the Ufa, the Belaja, the ı, and in the Belaja itself, as well as in many Kama rivers of the nment of Kazan. (Kanz.) 2. In Siberia. Exhumed elephant-teeth rory in many places of the eastern or Siberian Ural (P.). Elephant . on the right bank of Ural river, near Kalmukowa (P.); on the Tura, and ports in many places; on the Neiwa of the Tura; on the of the Winokurka and Suworifch of the Iset (P.). Greatly-destroyed .nt-bones of a bluish and blackish colour, in the bluish sand-marl, on :asch of the Iset, near Taimilskaja Sloboda (P.). An elephant jaw-with glossopetræ, on the bank of the Tura, noticed by Haller; er with ammonites from another place in Werchoturean Ural, was ɔ the Academy by Councillor Tatischew. An elephant-tooth was in the gold mountain of Beresow, 6 feet below the surface, in clay; :ermann considers this the highest place where these bones are found; nks of the upper Yenisei seem, however, to be far higher. Elephant- in many places of the banks of Tobol. Rotten, bluish elephant- and teeth, on the bank of the Ischim, near Petri Pawloskoi Krepost, ı the Karasu and Wagran of the Ischim. An elephant-tusk, 10 feet from the bank of the Ischim (P.). A hip-bone, 48 poods weight,* on nk of the Irtysch, near Oresk (P.).

phant-bones, in many places on the bank of the Irtysch, over Omsk; ı Kolywan, on the bank of the Alei of the Ob; in the high sand- (left) of the Ob, near Obdorsk (Suj.); in the Baraba, on the clay- in clay (P.). A rather rotten hip-bone in the Tom-Tschumysch ı of the Ob, where it was discovered in digging for a dam (G.); in many on the banks of the Tom. An elephant-tusk 5½ feet long, on the ei, near Krasnojarsk (Messerschm.); on the lower Yenisei, 620 * below Turuchansk, near Salakino Simowie, at the head of the Elephant-bones on the Angara and the Upper Tunguska (Comment. ɔ.). An elephant-skeleton, with a skull weighing 152, a tooth weigh- 0, and a thigh-bone weighing 25 lb., on the Wilvi of the Lena (Mes- .); in many places on the banks of the Lena; on the Argun, in :hinsk; on the rivers of the Polar Sea, Chatanga, Indigirka, and ıa, also on the Anadyr of the Baltic Sea (Comment. Petrop.); in ·ctic turf-fields on the Gulf of Kariss of the Polar Sea (Suj.); in the ns of the Lena and Wilvi, on the lower Indigirka, and many other (G.).

hinoceros-skull was discovered in the Obstschei Syrt above the na, others in many of the Kazan rivers.

ıinoceros-skull on the Ob, near Obdorsk, in Siberia; on the Tschitoi Selenga, in Dauria; on the Kinga rivers in Irkuzk, 30 versts of :k (Laxm.); in the turf-fields (*tundra*), near the Lena (Gm.); on ena, near the Swestoi, 200 versts of the ice-sea (Gm.); on the ·r, in turf-fields (P.). A rhinoceros-skull with two horns on the bank Indigirka, near Saschiwersk, where also two nose-horns without ull were found.

ıinoceros-head, with uncorrupted, partly still bloody and uninjured vas discovered a few years ago on Wilvi of the Lena, in a frozen eld (*tundra*), not very deep under the grass. The body was not ; it may perhaps be still lying in some other place of the ever- marshes, or perhaps it may, on its being embedded, not have been suf- ly covered against the action of the atmosphere, and thus the other

* A pood = 40 lb. † A verst = six furlongs.

part has rotted away. The head had not any nose-horn, and it could not be made out how the fleshy head had been separated from the carcass. In the open air its odour was very offensive, and it was only after undergoing a process of drying nearly approaching the first stage of carbonisation that it was possible to place it in the museum.

The museum contains five other rhinoceros-heads and five horns from various not precisely indicated places in Siberia.

Ox-skulls, and bones of a still unknown species, on the bank of the Swiaja, on the right, and of the Irgis, on the left of the Volga (P.).

Ox-bones, on the bank of the Ural river, near Walmukawa (P.), and on many places of the same bank (Steller, Pallas).

Ox-skull, on the Ob, near Obdorsk, where also bones were found (P.); on the Miäs of the Iset of the Tobol; on the Tura; on the Oi of the Ural river, in the steppes of Kirgis; on the Wilvi of the Lena; on the Tunguska of the Yenisei; on the Kuda of the Angara; on the Ilga, near the Ilginskoi Ostrog, on the Lena; on the Anadyr of the Baltic Sea; and in many places of Siberia (Nov. Com. Petrop.).

Bones, perhaps of a hippopotamus, on a branch of the Belaja of the Kama (P.).

Morse-teeth, in the arctic turf-fields of the Polar Sea, in many places pretty abundantly, and so fresh as to be used for ivory, and forming a branch of commerce.

An exhumed morse-tooth, 8½ lb. weight, on the Gulf of Penschia; another, weighing 5½ lb., on the Kamtschatka (P. Nord. Beitr.).

A bluish-tinged tooth, on the mouth of the Tagil (P.).

Exhumed whales' bones, on the bank of the Yenisei, near Kanditu Nos, also on the bank of the lower Lena (Gm.).

An exhumed twisted narwhal- (unicorn) tooth, on the lower Indigirka, near the Udjadinskoi Simowie, near the Anadirskoi Ostrog, in a moor. The museum possesses also an exhumed narwhal-tooth from the middle of Siberia.

Bones, transformed into limestone, were dug up on the Ischova, near Gatschina, 9 feet deep (Model).

In the striated limestone on the right bank of the Volga, near Saratow, hardened bones.

Bones with petrified wood, on the Lariwonicha of the lower Tunguska (Messerschm.).

Exhumed antelope-horns, at present known as an African animal, from Siberia (Pall.).

ERRATA.—Page 205, line 16, for "to be able" read "to have been able;" page 205, line 24, for "rocks" read "rock;" page 205, line 11 from bottom, for "there" read "here," that is, in Trinidad; page 205, line 5 from bottom, for "Brown" read "Bronn;" page 207, line 7, for "Astrea" read "Ostrea."

FOREIGN INTELLIGENCE.

Under the title of 'Considerations on Professor G. Capellini's Lecture on the Antiquity of Man,' Dr. L. Forresti has printed, *at Bologna*, the following remarks, which we translate from the Italian pamphlet:—

Three years ago, Professor Capellini, in one of his lectures on geology, alluding to the most recent discoveries made in the lakes of Switzerland

and at Abbeville, maintained that men lived contemporaneously with the cave-bear and other animals whose remains are found in caverns, and urged the necessity of further studies, especially of the crania discovered by Schmerling in Belgium.

In his professional course of the past year he again briefly touched on this topic, and during the present year has expressed his delight with the important writings of Lyell and Huxley,—reminding his audience that it was not since the publication of those works, but long before in the Italian University, that he had supported these ideas which are now so rapidly gaining ground, and had predicted the results now attained.

In his lecture referred to, the Professor gave an historical sketch of the pretended and true discoveries of fossil human remains, commencing with the fossil bones discovered at Chaumont in 1613, and attributed to the Cimbrian king Tetobochus, about which M. Mazurier, surgeon of Beaurepaire, speculated for a time; they were next transferred to the museum at Bordeaux as human bones, where De Blainville afterwards readily recognized them as belonging to a proboscidian animal. Then followed the story of the *Homo diluvii testis* discovered by Scheuzer, which, according to Grunner, in 1773, proved to be nothing more than a skeleton of a gigantic salamander; then that of the fossil man discovered at Fontainebleau, in 1828, which was found to be but a mass of fragments of *Arenaria conglutinata* sand, simulating the form of a horse and horseman; and so on, through various facts and fictions, to the discoveries of M. Boucher de Perthes in the environs of Abbeville, and the results obtained from researches since 1856 amongst the pile-works of the lakes of Switzerland, and those in the Italian lakes, especially in the Lago Maggiore, by M. Desor; also those in the peat and turf deposits and sea-shores made by Gastaldi, Moro, Strobel, and others.

Analysing Lyell's work, he showed how, by means of fresh observations on the remains in the Belgian caverns, the laws of progressive development and the origin of the species by variations are supported. In fact, Lyell and Huxley, by a comparison of the fossil crania found at Neanderthal and Engis, with those of the chimpanzee, the gorilla, and others, have been enabled to fix the relationships and the differences which exist between the present races of man, fossil man, and the various species of anthropoid apes.

From these studies, and those of Morlot, we are tolerably certain that fossil man is to be found in every post-tertiary deposit, and that the frequency of his relics sensibly diminishes the more remote the epoch; the same fact is likewise verified by the dog, the cow, and other animals, which were the earliest companions of man.

The Belgian or Engis man was contemporary with the cave-bear, but the Düsseldorf or Neanderthal was unlike the first, and showed such an analogy of structure with the pithecus, that at first sight it could hardly be believed to belong to the human genus. According to the theory of the origin of species by variations, it must necessarily belong to an epoch far anterior and difficult to calculate. Between the Belgian and the Düsseldorf man the Australian type ought to be intercalated.

Admitting these truths as confirmed by facts, we are still far from a certain knowledge of the species which ought to unite the anthropoid apes with the human species, although the question seems now to be nearer a solution, by the discovery of the Neanderthal cranium, which Professor Schaffhausen justly declared to be of all the human fossils the one which approaches most nearly to the ape; and close examinations have led to the conclusion that between the Neanderthal man and the gorilla, if judged by the capacity and form of their crania, there is less difference than exists between the former and the European race.

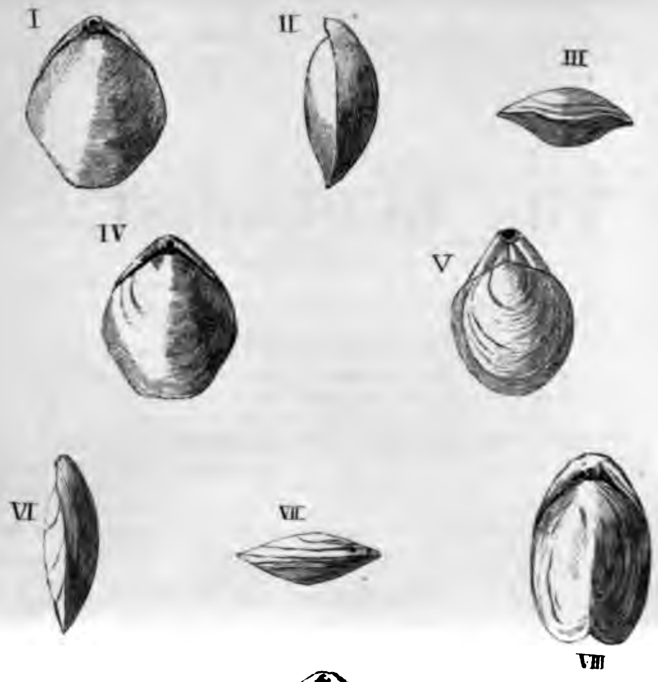
If we wish to establish the relation between man and the inferior animals we must necessarily admit, according to our Professor, that between the Neanderthal man and the more elevated type of the great family of apes, the Catarhines, or tailless, there is less difference than is seen between the inferior link of the Catarhines and the more elevated Platyrhines, or those with tails, and of which we ignore the transition species. We must, therefore, admit with Huxley, that the human species forms a natural family which can now be called the Anthropini, a family which is connected with the Catarhines in the same way as the latter is united with that of the Platyrhines, forming thus a superior group in the zoological scale, that is the Primates, a classification already adopted by the celebrated Linnæus.

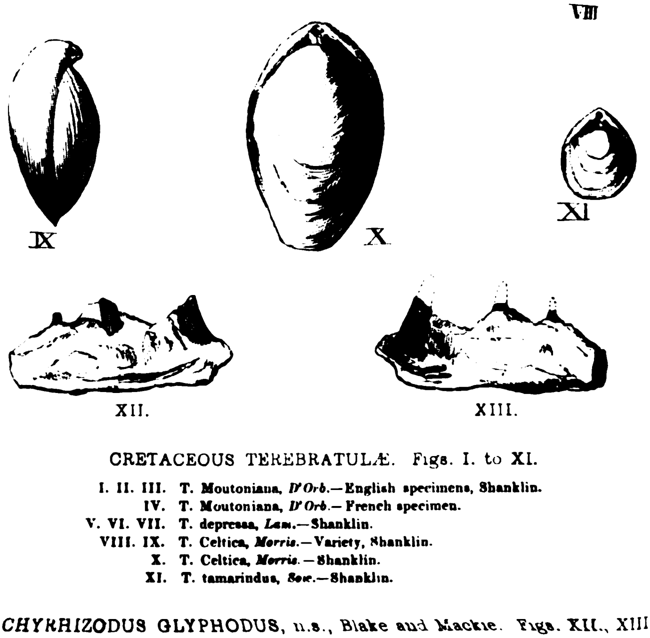
For geologists and palæontologists, therefore, there is a large field opened for research, and it will be their duty to endeavour to fill up the gaps and to find out the connecting links between the Anthropini and the Catarhines; and for this purpose we must turn our regards towards Central Africa, the islands of Sunda, Borneo, and Sumatra,—that is, towards the regions where the anthropoid species are chiefly developed, and there not in the recent formations but in those of the Tertiary period,—not confining ourselves to the Pliocene, but descending to the Miocene, and perhaps even to the Eocene.

These were substantially the subjects treated by the Professor, and of which Dr. Forresti had proposed to give an account at a time when the Professor himself gave an appendix to his former remarks in one of his subsequent lectures on fossil man, referring to the jaw discovered on the 28th of March, at Moulin-Quignon, near Abbeville, in the diluvial strata already alluded to, informing his audience at the same time of the many questions that had arisen on the subject, as well as of the meeting of the distinguished French and English palæontologists and geologists at Abbeville, in April, and of their mutual acknowledgment of the authenticity of the jaw, a drawing of which, sent him by the discoverer, was exhibited by the Professor.

This rapid succession of researches and discoveries induces great hopes for the progress of these studies.

M. Virlet d'Aoust asserts that the ophite of the Pyrenees is not an eruptive rock, but a metamorphic sedimentary rock; that it belongs to the Trias formation, and represents, with the gypseous and saliferous marls, the age of the Muschelkalk. Without resting content with isolated facts, M. d'Aoust proposed to assure himself whether, supposing the ophite to be a metamorphosed rock, its recognized position at Leez would not be its normal position. It remained to verify this, and he was agreeably surprised to find in the Barousse,—the *massif* of the mountains which separate the Haute-Garonne from the Hautes-Pyrénées,—exactly in the direction of the sections of Cierp, of Leez, of the Col de Mendé, the same succession of rocks, and to see the ophite, not only in the identical position, but also there elevated in the planes of the other rocks in natural order.





CRETACEOUS TEREBRATULÆ. Figs. I. to XI.

I. II. III. T. Moutoniana, *D'Orb.*—English specimens, Shanklin.
IV. T. Moutoniana, *D'Orb.*—French specimen.
V. VI. VII. T. depressa, *Lam.*—Shanklin.
VIII. IX. T. Celtica, *Morris.*—Variety, Shanklin.
X. T. Celtica, *Morris.*—Shanklin.
XI. T. tamarindus, *Sow.*—Shanklin.

PACHYRHIZODUS GLYPHODUS, n.s., Blake and Mackie. Figs. XII., XIII

THE GEOLOGIST.

NOVEMBER 1863.

BRITISH EARTHQUAKES.

BY THE EDITOR.

ENGLAND has been visited by an earthquake. The newspapers have dilated upon it, and hundreds of persons have hastened to record their sensations. They have told us how they got out of bed and lit their candles, as if they had hoped to have seen the earthquake, like a ghost, wandering about the earth; but earthquakes do not linger, and the last British one was over before most people knew anything about it. Others fancied they heard a great roaring noise; others compared the shock to a great dog or animal shaking itself under the bedstead; others to the vibrating of a steam-engine. Some saw leaves fall, walls shake, and some felt "a warm breath of air" upon their cheeks. In short, some told the truth as far as they could, and some told what was not quite the truth. If the truth had been simply stated, and the press had helped to state it by publishing as many letters as their correspondents chose to send them, we should have no other comment to make than to have thanked it for its pains. But when leaders were printed in such terrible paroxysmal terms, thanking Heaven we were not all swallowed up, we can scarcely regard such sensation articles as little less than impious. Earthquakes are of the most common occurrence, and science wants cool observations whenever they happen. No doubt they are, when their visitation is severe, amongst, if not *the* most awful of all catastrophes. To have a whole city thrown down in an instant, and thousands of suffering human beings crushed and lingering in agony beneath the ruins, is indeed a frightful scene, upon which the mind refuses to dwell. But where one earthquake assumes this fearful condition, hundreds, if not thousands, pass away as mere harmless, or nearly harmless, tremors. British earthquakes are by no means uncommon, as the following list will show, beginning with the earthquake recorded in A.D. 974, on the authority of Simon Dunelmensis. Then follow in succession—1043, stated in the 'Courrier Français' of March 27th, 1843. 1048, in 'Rerum Anglicarum Scriptores,' fol. 51, felt in Worcester, Derby, and many other parts. 1076, on the 26th of March, recorded by Matthew of Westminster, lib. ii. p. 6, as throughout all England, accompanied by subterranean noise; and more shocks were felt on the 6th and 22nd of the following April. In 1085, noticed by Lycosthenes. In 1089, Aug. 11th, at the third hour of the night, by Simon Dunelmensis, who says houses were seen to leap upwards and return to their positions, and that the harvest was not got in until the end of November in that year. 1099, on the 3rd of November, by Roger de Hoveden, in Rerum Anglic. Script. fol. 268. 1105, at Ely, noticed in the 'Gentleman's Magazine' for 1750. 1110, an earthquake lasting from morning to the third hour of the day, at Shrewsbury and Nottingham, is recorded by Simon Dunelmensis, after the Shropshire Chronicle of Henry de Knyghton,—the bed of the Trent is asserted to have been laid dry for a mile in length, so that it could be passed with dry feet. 1112, in partibus Britanniæ, Dom Bouquet, t. xii. p. 557; 1115, in Italy, and said to have been felt in England. 1117, Dec. 10th, in the middle of the night: Matthew of Westminster says the moon appeared the colour of blood. 1119, Sept. 28th, at the third hour of the day, in different parts of England, Simon Dunelmensis. 1133, Aug. 4th, in the morning, a very violent earthquake, preceded by very loud subterranean noises, is noted by Matthew of Westminster, Matthew of Paris, Polydore Vergil, and Simon Dunelmensis. 1134, on the coasts of England and the Netherlands, the sea rose suddenly with such violence as to inundate the country, and retired to its usual level as suddenly: no land shock felt. 1142, at Lincoln, three shocks on the same day, Simon Dunelmensis. 1158, London and other places. Thames dried up so that persons could pass; very violent in Syria,—recorded in Gervais' Chronicle. 1165, at Ely and in Norfolk and Suffolk; Matthew of Westminster says persons were thrown down, and the bells made to ring. 1179, near Arlington, Durham, ground swelled up and sank again with great noises,—possibly a local phenomenon. 1180, about the 29th Sept., two or three shocks are noted by Simon Schard and Lycosthenes. 1185, about April 16th, all England, especially at Lincoln, in which the cathedral and many other buildings were overthrown. 1186, after the middle of September, universally throughout Europe, especially in England, where houses were thrown down, and in Calabria and Sicily, where many towns were ruined, recorded by Matthew of Paris and Matthew of Westminster. 1199, principally in Somersetshire, persons thrown off their feet: Ymagin. Hist. Radulfi de Diceto, col. 709. 1201, Jan. 4th, York and neighbourhood, accompanied by noise; another shock on the 22nd May, at the sixth hour of the day, in Norfolk. 1202, in different parts of England. In the winter of 1218. 1219. 1221. 1246, June 1st, at the ninth hour, especially in Kent. 1247, on Feb. 13th, different parts, especially London. 1248, Dec. 21st, Bath and Wells (also in Piedmont, Savoy, and Syria), the summits of the cathedral of Wells being much shaken, whilst the foundations were not. 1250, at St. Alban's and Hertford, accompanied by subterranean noise; pigeons and other birds frightened. 1274, Dec. 5th, throughout England, accompanied, according to Matthew of Westminster, by thunder, lightning, a comet, and a fiery dragon; and, in the Pays-de-Galles, according to Polydore Vergil, by a rain of blood. In the September of the following year (1275), between the first and third hours of the day, Matthew of Westminster says many of the most famous churches in England were thrown down or injured; among others, that of St. Michel-du-Mont, near Glaston. 1278, in France and England. 1284, in England. 1298, Jan. 5th, at twilight. 1318, Nov. 14th. 1320. 1385, July 16th, at night, followed by another earthquake during the same year. 1426, throughout all Great Britain, the shocks, preceded by a dreadful tempest, lasting for two hours, recorded in Stow's 'Annals.' 1551, at Reigate, Croydon, Dorking, in Surrey; kitchen utensils and other movables, thrown from their places, noted in Strype's Memor. Eccles. In 1574, Feb. 26th, very violent in the central counties, from Bristol to York, occurring between 5 and 6 P.M.; it is recorded also at Gloucester, Bristol, Hereford, and neighbouring counties; at Tewkesbury and some other places, plates and books were thrown from their places; the people who were on their knees in the chapel of Norton were almost all thrown down, and the bell in the Market House of Denbigh sounded two strokes. 1575, Baker, in his 'English Chronicle,' says the Thames ebbed and flowed twice in an hour. 1580, April 6th, at 6 P.M., throughout England, especially at London, Dover, and the whole of Kent; also in France, in Belgium, Zealand, and Holland; most violent in England; lasted about a minute; two other shocks were felt in Kent, at 9 and 11 P.M.; at Sandwich and Dover, vessels dashed against each other in the harbours, the great bells of Westminster sounded, and portions of buildings and chimneys were thrown down in London, the sky clear and the air tranquil; another shock on the 1st of May in Kent, strongest at Ashford, occurred also in the Netherlands and as far as Cologne. 1588, landslip in Dorsetshire. 1597, shocks at Perth and other parts of Scotland. 1609, flux and reflux of the tide twice in an hour. 1638, at Chichester, several shocks did great damage; stated in the 'Dresdner Gelehrte Anzeiger' of 1756 to have been accompanied by the smell of pitch and sulphur, and that the atmosphere was obscured, as if by a cloud. 1657, July 8th. 1661. In 1666, at Oxford, Stanton, Coventry, etc.; and in Hungary rocks were cleft in pieces. September, 1671, on coasts of English Channel and German Ocean, and from St. Malo as far as Antwerp. 1677, Wolverhampton. 1678, Jan. 5th (new style), 8 A.M., on borders of Derbyshire, supposed direction E. to W.; and a second at 11 P.M., in Staffordshire, S. to N., preceded by subterranean noise, recorded in Plott's 'Staffordshire;' another on 20th Oct., at same places, at 11 P.M., preceded by loud noise, like prolonged thunder; at Brewood, etc., Nov. 14th, at 11 P.M., N. and S., repeated three times before 2 A.M.; Nov. 15th, less violent. 1680, Jan. 4th, 7 A.M., in Somersetshire and the country round; air calm; shock accompanied by a noise like a sudden gust of wind. 1683, Sept. 28th, at 7 A.M., Oxford, Berkshire, Buckinghamshire, and the shocks recorded at 4 A.M.; a man who was fishing in the Cherwell perceived the boat to tremble under him, and the little fish showed signs of alarm; accompanied by a low noise like prolonged thunder; weather wet to 20th, became fine on evening of 27th; a tin vessel thrown down; another, Oct. 9th, Oxford, north to Derbyshire, feeble at former, violent in latter county. 1688. 1690, Oct. 17th, Ireland; Dec. 18th, middle of night, in Bedfordshire and Scotland. 1691, Deal, Canterbury, Sandwich, and Portsmouth, said to last six minutes. 1696, Falmouth. 1704, Jan. 8th, most violent at Lincoln, N. and S., accompanied at Hull by a noise like the sighing of the wind, though air perfectly calm, doors and furniture set in motion, and chimneys thrown down. 1712, Shropshire, said to have been very violent. Another in

726, Nov. 6th, about 6 A.M., at Ilchester (?), a rather violent shock, ccording to the 'Gazette de France' of 30th Nov., the same shock eing seemingly felt in the north of Iceland, accompanied by an ruption of Krabla. 1727, Oct. 4th, Naples and England. 1731,)ct. 19th, Northamptonshire, accompanied by a noise like distant hunder (Phil. Trans. vol. x. p. 249); Oct. 21, at Bloxham, Barford, 3anbury, etc., when windows were violently shaken, followed one ninute after by brilliant lightning at Aynho; the day after, the sky .ppeared the colour of earth. 1734, in Sussex, and in France, at Havre, and as far as the other side of the Seine; atmosphere quite alm, weather became suddenly cold just before. 1736, Ochil Hills, n Scotland, accompanied by subterranean noises. 1748, July 12th, etween 10 and 11 P.M., Somersetshire and English Channel, to the 3evern, the shock appearing to come from a distance, accompanied y a noise like that of a waggon in motion. 1750, at Eltham, in Kent, about half an hour after noon; ten minutes later a violent shock is recorded in London, where there were other shocks on 19th March; in the 'Philosophical Transactions' chimneys are said to have been thrown down, and that the earth in St. James's Park seemed to swell up ready to open, and that fishes threw themselves out of the water; other shocks are recorded at various places on March 29th and April 13th, and at Wimbourne, Dorsetshire, on May 15th, and in Lincolnshire and Nottingham on Sept. 3rd, and in those and other counties, including Suffolk, on Oct. 11th. 1751, March 31st, Somersetshire. 1752, April 16th, Somersetshire. 1753, June 8th, Cheshire; July 18th and Sept. 26th, various parts. 1753, March 25th and 27th, at York, on the latter occasion (10 to 11 A.M.) large masses of rock were thrown down, and the surface of the ground disturbed. 1754, April 19th, at York. 1758, April 28th, Middlesex, and Mediterranean; Aug. 1, Northamptonshire. The 1st of November, 1755, was the day of the great earthquake of Lisbon; sensible shocks were felt in England only in a few places.

To continue our list—1755, Nov. 17th, in Cumberland and Herefordshire; Nov. 18th, Herefordshire; Dec. 18th, Herefordshire; Dec. 31st, Glasgow and other places in Scotland. 1756, at 7½, P.M., west of Ireland, preceded by an aurora; Feb. 13th, Middlesex and Kent, in connection with shocks in the Alps, Germany, and France; Oct. 17th, Argyleshire; Dec. 26th, Cornwall. 1757, July 15th, Scilly Islands and Cornwall. 1758, Sussex, Surrey, and Kent; Dec. 20th, London. 1761, June 9th, Sherborne, Shaftesbury, around for thirteen miles. 1762, March 16th, Wexford; March 20th, Shaftesbury, Dorsetshire. 1766, Jan. 10th, Glamorganshire. 1767, April 20th, west of Stirling, Scotland. 1768, Jan. 3rd, Northamptonshire; March 15th, Newcastle, Manchester, and Yorkshire; Dec. 21st, Worcester, Gloucester, etc., and in mountains of Scotland; Dec. 29th, Herefordshire. 1769, Nov., Inverness. 1771, April 29th, Berkshire; Aug. 24th, Cheshire. 1773, April 15th, Dorsetshire, in connection with St. Malo, Guernsey, Jersey. 1775, Shropshire. 1776, Oct. 28th, Northamptonshire, Leicestershire, etc.; Nov. 27th, Kent, also at Calais; Dec. 24th, Inverness. 1777, Sept. 14th, Lancashire, Derbyshire, Cheshire, Yorkshire, etc. 1780, August 29th, Anglesea, Caernarvon, etc., with noise like waggons; slight shock at Lisbon; Dec., North Wales; Dec. 18, Newcastle, York, Leeds, etc. 1782, Oct. 5th, Flintshire, etc., rather violent. 1783, April 23rd, Colebrookdale; Aug. 9, Cornwall. 1784, Dec. 6th, English coasts. 1784, south of Scotland, Isle of Man, and Dublin. 1786, at Lancaster, in Cumberland, at Newcastle, Glasgow, and Isle of Man—with rumbling noise. 1787, July 6th, Cumberland. 1788, July 8th, Isle of Man,—the sea suddenly receded at Dunbar. 1789, May 5th, Devonshire; Sept. 2nd, Perthshire; Sept. 26th, Shropshire; Sept. 30th, Edinburgh; Nov. 5th, Cromarty and Crieff; Nov. 10th and 11th, and Dec. 29th, at Comrie, Perthshire. 1790, Armside, in Westmoreland, violent, accompanied by an explosion louder than thunder; at daybreak two clefts were found in the earth, one of which was very deep and two hundred feet in length. 1791, Sept. 2nd, Comrie, Perthshire; Oct. 28th, in England. 1792, Feb. 25th, Lincolnshire; March 1st, Bedford, Leicester, Lincoln, Nottingham, etc., rather severe, tremulous motion; Nov. (?), Comrie, Perthshire. 1793, Sept. 28th, Salisbury and Shaftesbury. 1795, Comrie, Perthshire; Nov. 18th, from Leeds to Bristol, and Norwich to Liverpool, S.W. to N.E. 1796, Oct. 23rd, Ripon. 1799, Jan. 17th and Feb. 24th, Comrie, in Perthshire. 1801, June, Chester and neighbourhood; Sept. 7th, whole of Scotland—the centre seemingly at Comrie, Perthshire. 1802, Oct. 26th, Caermarthen, in Wales. 1805, Jan. 12th, Valley of Clwyd, North Wales; March 21st, in England. 1809, Jan. 18th, Dunning, Perthshire, preceded by subterranean noise, like thunder. 1812, Jan. 18th, Oxfordshire; May 1st, Gloucestershire, accompanied by a noise like thunder; Nov. 13th, at Portsmouth, a violent shock during the Caraccas earthquake. 1813, Sept. 24th Stamford, Peterborough, etc. 1816, March 17th, Sheffield, Nottingham, Linərby, etc., accompanied by a noise like a rising tempest; th, Inverness and country around for a hundred miles, centre rbance apparently Inverness-shire. 1817, June 10th, 16th, ı, Inverness and neighbourhood; also Aug. 7th, at Urquhart, t. 2nd, at Inverness; Nov. 9th, Yorkshire, Westmoreland, ıcashire. 1818, Feb. 6th, Coningsby, in Lincolnshire, and around; Feb. 19th, Aberdeenshire; Feb. 20th, Inverness, P.M., and Coningsby, etc., at 3 P.M.; April 19th, a smart ·xtending from Lincolnshire across Yorkshire; June 9th, we, Scotland; June 19th, Comrie, Perthshire; September, ıs; Oct. 31st, at Dalton, Lancashire,—a dreadful shock oc- n Ireland on the same day; November 11th, Inverness and with noise like thunder, bells rang; Dec. 7th, Bangor and North Wales. 1819, Feb. 11th, Ballenloan, in Glenlyon, ; Nov. 28th, Comrie; Dec. 4th, Amabree, in Scotland. ›mrie and Dumbarton, etc.; a strong earthquake of three Loch Lomond waters were agitated; April 6th, Cork and uring towns; April 11th, neighbourhood of Cork, both ac- ed by rumbling noise; May 20th, Wanlock Head, Dumfries; th, Barmouth, in Merionethshire; Nov. 28th, Leadhills and k, Scotland, and around for 10 miles E. and 5 miles W.; v. 29th. 1821, Oct. 9th, Stratheam, near Crieff, Scotland; nd, Comrie, Crieff, etc.; Oct. 29th, Glasgow, etc.; Nov. əadhills and Wanlock Head. 1822, Feb. 20th, near York; 3th, Comrie; April 18th, Crieff and neighbourhood; Sept. ar Newcastle-upon-Tyne, severe, accompanied by noise like . 1824, Dec. 6th, Portsmouth and south coast of England. ›ec. 25th, Loch Erne, and at Leadhills, Scotland. 1827, h, Anglesea, North Wales, and at Ripon, in Yorkshire. ec. 9th, Comrie. 1831, March 1st, Perthshire; March 2nd, ıd south-east coast, at 8 P.M., severe shock, windows rattled * 1832, Dec. 30th and 31st, Swansea, etc., in South Wales. arch 20th, Glengarry, Inverness-shire; Sept. 18th, Dorsetshire; th, Chichester. 1834, Jan. 23rd, Chichester and south coast, ıe point of greatest intensity seemingly a few miles N.W. of ter; Aug. 25th, in Perthshire; Aug. 27th, along Hampshire :c.; Sept. 21st and Oct. 5th, at Chichester—severe on the .ate, the earth trembling for two or three minutes; again, a ıock on the 12th January, 1835, during which year also were

* The writer remembers this distinctly.

shocks at Liverpool and other places in Lancashire on the 23rd Aug. In 1836, April 4th, in Shropshire. 1837, Oct. 20th, Cornwall and Devonshire. 1837, Oct. 27th, at Camelford, in Cornwall, seven shocks accompanied by a dull noise; Nov. 27th, another shock; Dec. 8th, at Stamford, in Lincolnshire, and twenty miles around. 1838, Jan. 14th, at Tynehead, in Northumberland,—the shock of sufficient force to throw down articles of furniture; the next day a rent was observed in the fields more than half a mile in length, "supposed to have been caused by the earthquake;" March 17th, Shrewsbury and neighbourhood,—an alarmingly vibratory shock, accompanied by a rumbling noise like a train of waggons,—bells rang; July 30th, Tureff, in Scotland; Sept. 14th, Adderbury, Oxfordshire; Dec. 23rd, Charnwood Forest, Leicestershire, with rumbling noise. 1839, March 20th, Glengarry, in Inverness-shire; May 10th, at Bridgewater; May 24th, Glasgow and Crieff; June 11th, north of Manchester; June 12th, Lancashire and north of Manchester; Sept. 2, Bristol, Newport, Cardiff, and South Wales; also at Shrewsbury, —felt most at King's Down,—severe; Sep. 10th, Monmouthshire,—severe; Oct. 23rd, over two-thirds of Scotland,—Comrie being one point of intensity; also numerous shocks occurred at Comrie constantly during the whole of this month; also, Nov. 24th, in Dorsetshire. 1840, Jan. 8th, Donegal; Jan. 31st, Feb. 29th, March 23rd, April 30th, July 31st, Aug. —, Sept. 9th, Oct. 31st, Nov. 29th, Dec. 31st, at Comrie, Perthshire. 1841, Jan. 31st, Caermarthen, etc., Wales; April 19th and 21st, Oban, in Argyleshire; Dec. 20th, Kintail, Scotland, and at Comrie, 6th, 18th, Jan. 31st, Feb. 26th, May 30th, April 13th and 30th, March 23rd, June 30th, July 2nd, 23rd, 25th, 26th, 30th, and 31st, Aug. 1st, 10th, 12th, 25th and 30th, Sept. 8th, 9th, 10th, 16th, 17th, 19th, 22nd, 23rd, and 29th, Oct. 5th and 23rd, Nov. 3rd, 5th, 6th, 7th, 8th, 18th, and 26th, Dec. 3rd, 6th, and 7th. 1842, Feb. 17th, in Cornwall; June 21st, in Lancashire; Aug. 22nd, in North Wales,—said to have been detected instrumentally at Prague. And at Comrie, Jan. 2nd and 7th, March 10th, April 21st and 22nd, June 1st, 2nd, 8th, 23rd, July 1st and 10th, Aug. 27th, Sept. 2nd, 24th, 25th, Nov. 18th and 29th, and Dec. 4th and 17th.

The above account of British earthquakes is abstracted from Mr. Mallet's elaborate general list, published in the Reports of the British Association, which goes up to 1850, since which date many shocks have been felt, especially one in 1852, through

Shropshire, Leicestershire, Cheshire, and generally over the same area as the one a few weeks since. Our list is, however, if not quite perfect, sufficiently complete to show how numerous, even in England, earthquake-shocks are, and how generally not dangerous nor violent in their effects. To establish this point was not our purpose in this article, but rather to raise discussion on an important question. All earthquakes are more or less of the nature of what are properly termed "shocks," and more commonly they are the effects of something *sudden*, more like the snap of a bar of metal or stone under tensile strain than an explosion of gunpowder or gases. Perhaps very generally they are the "shocks" of the rupture of masses of dense strata, or the sudden slippings of one great rock-formation over another. We ourselves pay little regard to the idea of a central fused mass, and the possibility of tidal waves in such an igneous ocean, and desire rather to seek for the cause with an unbiassed mind, and as proceeding from natural causes such as we are acquainted with. It seems to me that in the crystallization of rock-masses we have a power of the most enormous character, working, it is true, by atoms; and so does molecular force, and what more tremendous, more irresistible? Enclose water in a casket of iron; freeze it, and the casket bursts like a fragile china-cup. If in the crystallization of vast rocks, under the pressure of superincumbent strata, an expansion of their volume takes place, the superincumbent beds will be subjected to tensile strain, at first moderate, subsequently intense, and then a fracture or snap, or giving way. If the rock-masses contract in crystallizing, fracture from tensile strain is equally possible. A bar of iron, broken by tensile strain, snaps with the report of a cannon; so the snapping of the solid rock-masses below may produce sounds like thunder or the rumbling of waggons. The snapping of great masses of subterranean rock might give rise to great chasms, to uplifts of the edges, and large tracts of strata, while the vibration of the snap would ring through the earth for miles upon miles; its occurrence would be sudden, unpredicted, immediately dependent, perhaps, upon a sudden change of temperature, upon long-continued rain, or drought,—indeed, upon any unusual condition. Certainly, too, it is not a little singular that earthquakes are most frequent in the vicinity of the crystalline rocks of mighty mountains; in Chile along the line of the Andes, along the mountainous tracts of Wales, and the same in Scotland, along the Pyrenees, and most frequently of all along the most gigantic mountains in the world—the Himalaya. One can understand a rugged mountainous tract being uplifted, self-uplifting by expansion, by crystallization; but one cannot understand a mountain being permanently upheld on a gaseous explosion, or buoyed up by a generation of steam at high pressure. All such theories presuppose mighty caverns in the interior of the earth's crust, or the earth itself, for the generation of such steam or gases; and after that these have expended their energy, are we to suppose that the tract upraised reposes on nothingness? Is it not worth studying to find out *what* effects the crystallization of vast rock-masses are capable of producing?

NOTES RESPECTING THE ORIGIN OF THE WORLD.

By Thomas Harrison, of Melbourne.

The tyro in geology usually experiences no small difficulty in realizing the present theory of the world's formation. The various sedimentary rocks are of such vast thickness, that the question is very naturally put, as to where such an immense amount of detritus could possibly have been originated; and although not exactly so taught in elementary works, there are few students of geological science who do not come to regard granite as being not only the foundation of the globe, but also the grand storehouse whence, in the shape of water-worn and eroded fragments, has been obtained the whole mass of the purely aqueous strata.

With the above questions come yet others: Whether there is a possibility so hard a material could be so completely broken up as to form clay-slates, mud-stones, and others of almost impalpable grain and texture? Whether there is good ground for supposing lime, magnesia, alumina, and iron are found sufficiently plentiful in any species of granite to have given rise to the extensive deposits of such minerals found in particular formations? and also, how it is that various rocks, all proceeding from the parent granite, should differ from each other in their component parts so materially, merely as such rocks have been the product of different geologic ages?

The first of these questions is generally referred to almost an infinity of time, during which the erosive action has been going forward; whilst sorting of materials, chemical changes, and the influences of organisms, in the shape of plants and animals, are put forward as affording satisfactory explanations of the two following difficulties.

The case, however, even admitting the correctness of the preceding propositions, can hardly be regarded as clearly proven. The respective thicknesses of the three different formations—primary, secondary, and tertiary, are in the very inverse order of what might be expected ı such a series, successively accumulated from the wearing away of a original indurate mass by a primeval ocean. Since, by the above ıeory, the primary rocks have only one source, the granite, whilst the ›condary have at least two, the same granite and also the compara-vely soft strata of the primary deposits, from whence these several aterials might have been derived,—it requires but little discernment › see that, allowing an equality of time for the production of each, ıe latter ought to be immensely the greater of the two. The fact , however, the directly opposite; whilst the tertiary, derivable from ıree distinct sources,—to say nothing of volcanic agency during ıis last period,—is far smaller in its development than either of the ueous formations immediately preceding. Nor is it fair to demand longer period for the accumulation of the older strata; since the rth being, in those ages, comparatively new and unsettled, it can arcely be supposed that the times of quiescence allowing deposi-›ns to go forward would be more extended than in the latter geo-gic ages, during which the earth may be regarded as approaching a ate of actual repose.

One might also reasonably expect, under the circumstances, to ıd the water-worn materials, of which the sedimentary rocks were rmed, growing gradually smaller in all the latter deposits, since ese last must necessarily have been subjected to by far the greater ıount of wearing action from their frequent changes of position. ere, again, facts are decidedly against the theory of primitive gra-te being the origin of the earth's sedimentary crust,—conglomerates ıd gravels being rare in the secondary, and almost unknown in the ıte rocks; whilst modern tertiary gravels, containing pebbles, and en angular fragments of quartz and granite, are common in every ıd wherein tertiary deposits are to be found at all.

Granite, again, is believed to have been produced under immense essure,—a condition altogether irreconcilable with the idea that such anite was formed as a surface rock. The weight too of granite ›uld appear to offer a most striking argument against its assump-›n of so high a position upon the gradual cooling of the earth's ma-rials, some of which are known to be of very trifling density.

But even supposing the great framework of the globe to be of gra-te, still we cannot help agreeing with Mr. Jukes that the analogy awn from the phenomena observed upon the cooling of lavas and her molten matter, would rather suggest the surface of recently lidified earth must necessarily be covered by vast heaps of ashes, oriæ, and such light materials as naturally floated above the recently uid mass below.

Admitting the above supposition as reasonably correct, we have at ıce an immense amount of material, likely to contain portions of ›ry many of the substances, the bulk of which sank by their supe-or gravity towards the earth's centre; and besides, matter espe-ally in a condition such as would admit of the mass being easily roded and swept away by the storms and tempests, in all probability ıcidental to such an early period. The detritus of this material would go to form the lower strata of the globe, whilst the upper might owe their origin both to the subsequent erosion of the first strata deposited, and also to vast eruptions of volcanic matter from the interior of the yet unsettled earth. The admission of the latter, the volcanic agency, fully accounts for the great variety of minerals and metals found deposited in rocks during different ages, whilst the varying character of lavas ejected in the same localities, yet separated by long intervals of time, would in some measure show the reasonableness of the supposition that the interior of the globe is in reality the grand repository whence every mineral had its origin.*

Assuming the nebular theory to be correct, the following would appear to be the sequence of changes occurring during the earth's formation.

All matter existing originally in the form of a gaseous mass, the particles of which were kept separate by the contained caloric, on cooling to a certain point, the least easily volatizable parts would assume either a solid or a liquid form. Immediately on this taking place, the particles so forming, would of necessity rush together by the force of gravity, and must inevitably meet and form a solid or liquid nucleus to a surrounding nebulous atmosphere. The contained heat of the nebulous atmosphere still further decreasing, other solid or fluid matter would be formed, and would be deposited in the form of a stratum upon the solid or liquid portion first originated. In this way would be built up, as it were, a vast globe, whose materials would be arranged in layers or strata, the order or position of which would be the order in which they respectively solidified.†

During the formation of such a globe, it might sometimes happen that a stratum of a greater specific gravity would immediately succeed one of less. If the former chanced to remain a fluid, it is evident the two would be placed in a state of instable equilibrium, and that the, at first, lower stratum would, by the inevitable laws of gravity and hydrostatics, ultimately assume the higher position. This state of things may be realized by imagining iron or other light metal and mercury to be introduced, both in a state of vapour, into the same receiver. If the lighter metal were the first to assume the solid form, it would be naturally deposited upon the bottom of the containing vessel, but would rise to and float upon the surface of the mercury immediately on the latter's condensation.

Applying this theory to the formation of the globe, let us suppose the granite at a given period to have been already precipitated, the heat of the nebulous mass being diminished by a required amount; and upon this layer of granite to be subsequently thrown down a fluid of

* In New Zealand there is said to be miles and miles of fine steel-dust covering the seabeach to a considerable depth; this dust is supposed to be ejected by volcanic action.

† So far, most part of the above theory is identical with that of M. Ampere, noticed in the 'Edinburgh Philosophical Journal,' vol. xviii. p. 339. The author, however, begs to state that he never heard of M. Ampère's theory until long after his own had been elaborated.

reater specific weight, such as we know to be liquefied lava, trap, and asalt. Although specifically lighter, the granite crust might for a ong time remain in its original position, forming, as it were, the ottom of the superincumbent molten ocean. On such ocean of olten materials would float the scum and scoriæ previously alluded). Of such scoriæ would be formed the various strata, by erosion id subsequent deposition. Portions of this scoriaceous mass being i immediate contact with the molten materials, might be metamorhosed into gneiss, without being first redeposited by water; whilst hists and slates may represent those strata deposited by water and terwards metamorphosed by heat, through being brought into fresh ositions, as a result of convulsive movements.

This state of things, however, could scarce continue; as the molten cean penetrated the granite, or as portions of such granite became osened and detached, immense fragments would necessarily rise to e surface, causing earthquakes, elevation of mountain-chains, or solute protrusion of granite peaks,—just as the detached masses were rge enough to cause the phenomena, or as the solidified crust was sufficient thickness to offer resistance to the immensely powerful evating forces thus acting from beneath.

It will be remarked that the assumed position of the granite in this eory exactly tallies with the hypothesis which supposes the granite have been produced under an almost inconceivable amount of presre, whilst the elevating forces thus necessarily generated by hyaulic agency alone, are so vast as amply to account for the throwing of any mountain-chain whatever. Nor must it be forgotten that e rising of such a semi-molten mass as the granite, by breaking of e partially consolidated crust, might bring within the influence of e central heat, rocks which, during the period of their aqueous depoion had been subjected to a very low temperature, thus accounting th for the deposition and the change by heat of the slaty strata.

It is not argued that the above suggestions, which the author puts rward with the greatest diffidence, offer an explanation for every served phenomenon in the earth's structure. Universal theories, ce universal medicines, are ever open to suspicion. In the formaon of a world it is probable that every known force played its apinted part; neither is it assumed that continued risings of the anite mass are the causes of modern earthquakes or volcanos. Both these may be the result of chemical and electrical action. The thor simply gives what is, to him at least, a partially new theory, usting there may be at least one proposition contained in it which, y promoting discussion, may lead geologists one step nearer the uth; while he is fully prepared to relinquish the hypothesis wheneer future examination, or further discoveries, show it to be false.

ON CERTAIN CRETACEOUS BRACHIOPODA.

By E. Ray Lankester, Esq.

In the Plate accompanying this paper are figured three species of Terebratulæ, which the writer lately obtained from the Lower Greensand beds of the Isle of Wight. Two of them are interesting as being entirely new to these strata in Britain, whilst the third is a remarkable deformity of a rare species. In Fig. 1, 2, 4, a shell is drawn which appears to be identical with the *Terebratula Moutoniana* of D'Orbigny, a species not uncommon in France, associated with *T. sella* in the Upper Neocomian and Aptian beds of that author. It is somewhat oval in shape, depressed and elongated; surface entirely smooth. The perforate valve is rather more convex than the other, truncated by a foramen of moderate size; deltidium very short and small. Nine specimens of this species were obtained from the ferruginous Greensand beds, at Dunnose Point, near Shanklin. This shell, on external examination, is easily distinguished from *T. sella*, which it somewhat resembles, by the absence of any biplication on the frontal margin. Its internal structure proves it to belong to the section Waldheimia of King, which precludes all doubt as to its specific distinctions from *T. sella*. It is easily distinguished from *Waldheimia Celtica*, Morris, by its less elongated and gibbous outline. The specimen drawn in Fig. 5, 6, 7 is the only specimen of the kind which the writer has obtained. The valves are lenticular, beak much produced, foramen very large and circular, deltidium large. Mr. S. P. Woodward is inclined, with the writer, to regard this shell as *Terebratula depressa*, Lamarck (*T. nerviensis* of D'Archiac), a species which has not hitherto been found, excepting in the Upper (?) Greensand beds of Farringdon, and in the Tourtia of Belgium. Since, however, two species, *T. tamarindus* and *T. oblonga*, are already known as common to the strata of Shanklin and Farringdon, it is not surprising that *T. depressa* should have a similar vertical range. In Fig. 8, 9, a curious deformity of the *Terebratula Celtica* of Morris is drawn. This specimen was obtained from the same locality as the two former species. The beak is very much produced and incurved, whilst a deep furrow or groove runs along the median line of the perforate valve, and a corresponding elevation marks the smaller valve. *T. tamarindus*, "a rare British cretaceous fossil" (Dav.), was also obtained in considerable quantities,—Fig. 11.

The rarity of some species and the paucity of any great variety of the forms of Brachiopoda in the Lower Greensand strata of England as compared with the large number of species characterizing the Continental beds usually considered as their "homotaxis," is somewhat remarkable. There is no obvious reason why such forms as *T. diphyoides*, *T. hippopus* and others associated with a common British species, *T. sella*, in the Upper Neocomian or Urgonian beds

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

FOSSIL BIRDS.—Facsimiles from Mylius, Hermann, and Ritter.

France, should not be met with in this country; and it is to be hoped that careful search will bring some of them to light to fill up the vacant spaces in our lists of species. The following are the species of Terebratulidæ, identified by M. D'Orbigny in France, and by Mr. T. Davidson in England, from Neocomian and Greensand strata.

Lower Neocomian.—*Terebratula tamarindus, T. pseudo-jurensis, T. prælonga, T. faba,* T. Moreana, T. Carteroniana,† T. Collinaria,† T. Marcousana, T. semistriata, T. hippopus, Terebratella oblonga, T. reticulata, T. Neocomiensis, Terebratulina biauriculata, Terebrirostra Neocomiensis.*

Upper Neocomian or Urgonian.—*Terebratula hippopus, T. dichyoides, T. Moutoniana, T. sella.*

Aptian.—*Terebratula Moutoniana, T. sella, Terebratella Asteriana.*

Lower Greensand (England).—*Terebratula tamarindus, T. prælonga, T. Celtica, T. sella, Terebratella oblonga,* to which I now add *T. Moutoniana* and *T. depressa.*

FOSSIL BIRDS.

By the Editor.

The wonderful remains of the Archæopteryx, recently acquired for the British Museum, have naturally drawn attention to a much-neglected department of palæontology; and it will therefore not only be interesting, but useful also to the advance of science, to pass under review, at the present time, the state of our knowledge of the former existence of birds during past geological ages. The early authors, for the most part, speak not of fossil bird-remains properly so called, but in reality of mere incrustations by "petrifying springs," of the fanciful tracery of dendritic markings, or the imagined resemblances of oddly-formed stones. Thus Albertus Magnus, in his book 'De Mineralibus,' printed in 1495, describes a fossil nest, with eggs, on the branch of a tree. This might or might not be a true *fossil*, but our recent discoveries of fossil birds and reptiles' eggs, and the knowledge we have now of delicate objects truly fossilized, such as insects, fruits, flowers, and feathers, renders it possible that some of the old records of such may have had a foundation of truth, and gives a probability that some at least may be brought within the capacity of belief as actual facts.

With this view, we shall quote from the old authors all the passages known to us, commenting on them as occasion may require; and in thus working up the bibliography of fossil ornithology and arranging

* The shell to which M. D'Orbigny has erroneously applied Sowerby's name of *T. faba*, is identical with the *T. Celtica* of Morris. The *T. faba* of Sowerby is merely a variety of *T. biplicata* confined to Upper Greensand strata.

† *T. Carteroniana* and *T. Collinaria* appear to have been regarded in this country as forms of *T. sella.*

the whole of our knowledge of the subject, as far as we have the power to do so, we shall be able to separate facts from fictions, and give a solid basis for further investigations in the future study of ornithological palæontology.

The first record of any allusion to petrified bird-remains is by ALBERTUS MAGNUS, in 1495. His remarks evidently refer to those incrustations by calcareous springs which we should never now dream of associating with true fossils. Still, it is necessary for our purpose to record these, that the true may be separated from the doubtful; while moreover these instances, if at all reliable, will serve the good purpose of illustrating the conditions under which true fossil ornithic relics may have been produced in the former geological ages of our earth. Such records are not to be cast aside as useless, for more reasons even than these. The following is the account given by this naturalist Bishop of Ratisbon in his 'Liber de Mineralibus,' published at Venice:—

"In our time there was discovered in the Danish Sea, near the city of Lubeck, a big branch of a tree, whereon a nest of birds was found, and small woodpeckers in the nest, all converted into stone of a reddish colour; the which cannot be otherwise explained than that the tree, at the time when the nest was in it, was rooted up by a storm, and the birds, drowned in the water, were afterwards, by the effects of local circumstances, entirely converted into stone. There is also in Gothia a spring, respecting which tradition states that everything that is immersed in its water is converted into stone. The Emperor Frederick, wishing to ascertain the truth of this, ordered some sealed parchments to be put therein; these having been kept there for a few days, the half of the skin, and the seals that is, the part submerged in the well, was changed into stone, the other part still remaining as it was. It is also positively stated by trustworthy people that the water-drops, which are dashed here and there by the force of the spring, are converted into as many stones as there are drops; the water itself however is not changed into stone, but continues to flow. We witness also the formation of crystals in the most elevated mountains perpetually covered with snow, which phenomenon cannot be ascribed to any other cause than to the virtue of the minerals which exist in those places. From all which we see that it is very difficult to determine the place of generation of stones, the more so as they are formed not from a single but from many elements, and not under any special but under every climate; and what seems more marvellous, they are generated as well in the bodies of animals as in the clouds, and their formation in all of these places renders it scarcely possible to reduce them to the same common matter. But as we cannot doubt that for a body of a compound nature there must be a generative cause, so it must be thence inferred that every kind has its peculiar place of generation, outside of which it decays and corrupts."

"Aliquando namque tempore nostro in mari Danico juxta civitatem Lubiensem inventus est ramus magnus arboris, in quo erat nidus avium: et aves pice in nido: et converse in lapides erant parvi in nido parum declinantes ad rubedinem quod aliter esse non potuit nisi quod procellis vel undis evulsa arbor tempore quo in ea fuit nidus et aves in aquam ceciderunt: et postea, per virtutem loci in quo jacebat, in lapidem universa conversa sunt. Est autem fons in Gothia: de quo verissime traditur, quod omnia que merguntur in ipsum in lapidem convertit: in tantum, quod ad eum misit Imperator Fredericus cirotecam sigillatam ut probaret veritatem, que cum per aliquot dies medietas corii et medietas sigilli mersa erat in fonte: medietas corii et medietas sigilli conversa sunt in lapidem, altera medietate corio manente. Refertur et veraciter a fidedignis quod gutte que ex impetu casus ejusdem fontis sparguntur, super ripam fontis convertuntur in lapidem guttarum quantitatem habentes: cum tamen aqua que sic fluit non convertatur in lapidem: sed fluit continue. Videmus etiam oculis generari cristallos in montibus altissimis: qui sunt perpetuarum nivium: quod iterum esse non potest nisi per virtutem minerallium que est in locis illis. Ex quibus omnibus videtur non posse certum aliquid tradi de loco generationis lapidum: cum nec in uno tamen elemento: sed in pluribus nec etiam in uno tamen climate sed in omnibus. Et quod his mirabilius videtur, in corporibus animalium generantur et in nubibus, que omnia loca difficile videtur, valde ad unam materiam in communi reducere: cum tamen hoc sit necessarium, eo quod non dubitamus ejusdem corporis mixti secundum genus etiam unum secundum genus esse generativum. Oportet enim quod omnium generatorum sit locus aliquis sue generationis, extra quem corrumpuntur et destruuntur."*

The next earliest author is GEORGIUS AGRICOLA (1546), in whose work, 'De Natura Fossilium,' lib. x. p. 370,† he says:—

"Like the wood of the blackthorn, but not the same, is a fissile stone at the base of the mountain Melibocus, or, as it is now called, Hercynium, near Eisleben, Mannesfeld, Hostedt; it is black, bituminous, and full of brass, and when extracted from the pits it is first spread on the field, and being thus accumulated forms a heap. Afterwards the lower part of the heap is surrounded with twigs, wherein likewise some of the same stones are thrown, and then the twigs are set on fire; the stones which are at the top of the twigs take fire, and communicate it to the others close by, and these kindle the rest. This faculty of being easily ignited is a common characteristic of bitumen and sulphur. However, they show but small veins of pure and black bitumen, and while burning they emit a smell like that yielded by bituminous coals when blazing. When, at the time they are burning, some rain falls on them, they burn brisker and soften quicker. Likewise, when the smoke which rises upwards is cast by the wind on to standing water, there is quickly a sort of bituminous matter to be perceived on the surface, all of which sufficiently proves that these stones are bituminous. The stones

* ALBERTUS MAGNUS, 'De Mineralibus,' lib. i. p. 3. tract. f. cap. vii., edit. 1495.

† The works of Agricola are—'De Ortu et Causis Subterraneorum,' lib. v. 'De Natura eorum quæ effluunt ex Terra,' lib. viii. 'De Natura Fossilium,' lib. x. 'De Veteribus et Novis Metallis,' lib. ii. 'Bermannus, sive de Re Metallica Dialogus.' 'Interpretatio Germanica Vocum Rei Metallicæ, addito Indice fœcundissimo.'—Basileæ, edit. 1546.

of this kind met with in the forest of Hercynium are sometimes covered with a crust of sparkling gold-coloured pyrites. They represent also now and then figures of animals, as for instance, of kinds of fishes: Flat-fish, Pikes, Perches; of the bird-kind: cocks, hens; sometimes also salamanders. Nay, even an image of a bearded Roman pontiff, wearing on his head the three-storied crown (tiara), has been discovered, and which has been seen by many. Besides this, the image of the Holy Virgin also, holding the baby in her arms. There appear also sometimes in *Chattis* species of fish of this sort of incrustations.

"Lastly, at Anneberg, on digging the Thomashirn pit, a bituminous ore has been discovered, which, thrown on to live coals, burned and yielded a smell like wild garlic, and finally was reduced to ashes, containing but very little silver."

The following is a transcript of the original text:—

"Spino similis, si non idem, est lapis fissilis ad radices Meliboci montis, sive, ut nunc vocant, ad Hercynium effossus Eislebæ, Mannesfeldi, Hostedæ: is niger, bituminosus, ærosus, primum ex puteis extractus in aream effunditur, atque ita ex ista coacervatione oritur tumulus. Deinde inferior tumuli pars circundatur sarmentis, in quæ similiter injiciuntur id genus lapides; tum sarmentis admoto igni accensis, ignem etiam concipiunt lapides super ea conjecti. Hi proximis quibusque impertiunt ignem: atque omnino omnes qui jam ardent, eis proxime adjunctis, ut autem facile ignem concipere signum sit bitumini commune cum sulfure: tamen parvæ puri et nigri bituminis venæ interdum ejusmodi lapides distinguunt: et, cum ardent, talem odorem emittunt qualem carbones bituminosi cum flagrant emittere solent. Præterea si quando in ardentes mediocris pluvia decidit, magis ardent, et citius mollescunt: quinetiam ubi ventus fumum qui sursum fertur, in proximam aquam stantem dejecerit, mox in ea innatare aliquid instar liquidi bituminis licet cernere, quod vel nigrum est, vel fuscum, vel purpureum: quæ omnia satis declarant eos lapides esse bituminosos. Atque id genus lapidum, ad Hercynium nemus inventum, crustæ interdum scintillis pyritæ aurei coloris adhærentibus. Et discurrentibus exprimunt varias animantium species, ut in genere piscium passeres marinos, lucios, percas: in avium gallos gallinaceos, nonnunque salamandras. Imo pontificis Romani barbati, et triplicem coronam in capite habentis, effigies reperta est, quam multi viderunt. Præterea beatæ Virginis puerum in manibus gestantis. Reperiuntur etiam in Chattis interdum species piscium in istius generis crustis. Nuper etiam Annebergi, cum ageretur Thomashirni cuniculus, effossa est cadmia bituminosa, quæ in prunas conjecta ardet, ac olet allium sylvestre et tandem in cinere abit, parve vero argenti in se continet."

The work which, so far as we know, follows in sequence, is the 'De Thermis ANDREÆ BACCII, Elpidiani, Civis Romani, apud Sextum Quintum Pontificem Maximum Medici, Libri Septem, Opus Locupletissimum, non solum Medicis necessarium, verum etiam studiosis variarum rerum naturæ perutile, etc., Venetiis, 1588,' p. 274; in which, discoursing "*on the nature of the salt growing in* TRANSYLVANIA," he says, "Of the nature of rock-salt and bay-salt,

* Also in edit. Patavii, 1711, lib. v. cap. iv. p. 157 (word for word).

which seem to grow and increase from moisture and springs, we have already sufficient information conveyed to us by Vernherus; we may, nevertheless, add here some facts deserving of notice which we have retained in our recollection. Amongst others, whilst the salt destroys common iron, there have been iron-implements and wood discovered after having been left for years in it. In a certain place there was a hen found which, together with her eggs, had been buried in salt and was thus preserved, and is still exhibited uncorrupted."

The Latin text is given below:—

"*Salis Natura quæ vegetatur et crescit in* TRANSYLVANIA.—Salis vero scissilis ac montani naturam ex humore aut succo id genus aliquo vegetari, ac crescere, satis quidem fidem facit idem Vernherus; nec minus ex nostris præclari aliqui testes, qui multa mihi hac in parte memorata digna retulere, quæ referam. Inter alia vulgare fere dum sal exciditur, relicta elapsis annis instrumenta ferrea, ac ligna in eis reperiri. Quodam loco gallina cum ipsis ovis incubans reperta est, quæ eo obducta sale servata est, ac incorrupta etiam nunc ostenditur. Jam magna ex eis fodinis carbonum vis erui solet cum sale et vetustissimæ roboris trabes. Sal gemmeus, qui lucidior est omni sale, cum in fundo reperitur, indicium fodientibus est inferius nullum esse salem, aut impuram terram, ceu matricem reperiri. Abundat et vicina Polonia hujus generis nativo sale saxeo in syncero tamen, ac magis solido."

The quotation which follows is from the work of JOH. DAN. MAJORIS, Phil. et Med. D., 'Dissertatio Epistolica de Cancris et Serpentibus Petrefactis, ad Don. D. Philippum Jacobum Sachs à Lewenheimb. Medicum in Rep. Patria Vratislaviensi, cui accessit Responsoria Dissertatio Historico-Medica ejusdem Philippi Jacobi Sachs à Lewenheimb. Phil. et Med. D. et Collegii Naturæ Curiosorum Collegæ de Miranda Lapidium Natura,' p. 38. — Jenæ, 1664:—

"In the meantime we are certain that not only crabs (river- and sea-crabs), but also serpents, lizards, sea-urchins, star-fishes, scallops, cockles, oysters, shell-fish, clams, limpets, tellens and turbines, and vertebræ and spines of fishes, as well as *beaks of birds* and parts of other animals, as, for instance, teeth, nails, vertebræ, skulls, etc., through natural as well as artificial causes, are often encountered in the depths of the mountains and in the most hidden recesses of the earth, where neither man nor any other animal could ever penetrate; nay, they are sometimes discovered even in the very middle of marbles, that show not the slightest fissure, their bodies, either previously petrified or in their natural state, having been, so to say, buried in the abyss of the earth, at the occurrence of the Deluge or by some other cause, and which remaining there have acquired the hardness of stone, as might easily occur through the infiltration of saline springs penetrating through every portion of the earth. We observe also on ancient walls nitrous water oozing through and coagulating into white icicles of a conical form."

The original runs—

"Credamus interim non cancros solum, sive marinos, sive fluviatiles, sed angues etiam, lacertos, echinos, stellas pisces, pectines, cochleas, ostreas, conchas, chamas, mitulos, tellinas, turbines, piscium que vertebras aut spinas, necnon *rostra avium* aut aliorum animalium partes, dentes vidl. ungulas, vertebras, crania, et alia, tam a natura quam arte petita, in intimis sæpe montium visceribus, aliisque profundis terrarum latebris, quo nulla unquam gens, nullum unquam animal aliud facile penetrare posse videtur, immo in mediis interdum marmorum, in nullas rimas hiantium, corporibus, sive petrefacta jam, sive pristinam naturam utcumque servantia, eatenus reperta esse, quatenus talia, ut verbo dixerim, voragine terræ fuerint obruta, sive occasione Diluvii, sive casu alio; ibidemque per plurimos annos subsisterint, donec destructa sensim obnoxia etiam reddita Rigori Lapidifico, qui facile tandem supervenire ipsis potuit ob transsudantes passim Salinos, per Terram Succos, haud aliter, atque in muris antiquioribus Aquam nitrosam transudare, ipsamque in Stiria albas et conos coagulari conspicimus," etc.

JOH. DAN. MAJORIS, Phil. et Med. D., 'Dissertatio Epistolica de Cancris et Serpentibus Petrefactis, ad Don. D. Philippum Jacobum Sachs à Lewenheimb. Medicum in Rep. Patria Vratislaviensi, cui accessit Responsoria Dissertatio Historico-Medica ejusdem Philippi Jacobi Sachs à Lewenheimb. Phil. et Med. D. et Collegii Naturæ Curiosorum Collegæ de Miranda Lapidium Natura,' p. 38.—Jenæ, 1664.

Joh. Weilhard Valvasor, in his 'Ehre des Herzogthums Crain' (Lanbach, 1689), says, "Near Landspreis, on the mountain, I discovered in a ditch many sea-shells, which had acquired a stony hardness, or rather which were converted into stone; also a *bird's nest* together with a small bird sitting on eggs; which all together was transformed into hard stone by the lapidiferous spirit."

We extract the original passage from Theil 1 of this work, p. 478.

"Bey Landspreis, über dem Berge, bin ich in einem Graben auch vieler Meer-Muscheln ansichtig geworden, die eine steinerne Härtigkeit gewonnen, oder vielmehr die Stein-Art selbst angenommen; ingleichen eines Vogel-Nestes, mit einem kleinem auf den Eyern sitzenden Vogel; welches alles miteinander der Stein-machende *Spiritus* zum harten Stein gemacht."

Like all other books of its age, Peter Wolfart's 'Vale Hanoviæ et Salve Cassellæ' (1707) has a very long title,* and more of a dilettante than a philosophic aspect. Medicinæ Doctor Wolfart has, however, something to say, and we will therefore let him say it in his own words (p. 12, etc.).

"§ IV. In order to enable every and any one the better to understand our *figures*, and to avoid confusion of them, we think it advisable, for the interest of the work, not to notice obscure or futile opinions about the origin of the specimens,—abundant as such opinions are, according to the fertility of the genius of every writer,—

* 'Vale Hanoviæ et Salve Cassellæ dictum. Cujus Occasione Inventa quædam Hanoica utrisque Dilectissimis suis Popularibus Communicare, se suaque Studia de Meliori Commendare, atque prioribus benevolam sui memoriam relinquere voluit. PETRUS WOLFART, Med. Doct., in Illustri Schola Patria Anatomiæ hactenus et Philosophiæ Experimentalis Professor, nec non utriusque Hanoviæ Physicus Ordinarius, nunc vero Physicus Aulicus Hasso-Castellanus, cum ad Stationem suam novam capessendam, Abitionem paratet. Anno Christi, 1707, die 18 Aprilis, Francfort ad Mœnum.'

and to separate the whole into two distinct classes; ascribing to one those which seem to be mere playthings of Nature, and to the other those due to the universal deluge, by which, according to what we learn from the sacred Scriptures (Gen. vii. 19), the whole earth was drowned and the highest mountains covered with water.

"§ V. In the first class we will arrange all those fossil bodies which represent various superficial images,—figures of ants, beetles, peacocks, fishes and other animals, and which, it seems, had been already frequently observed in the time of Pliny, who refers to them in his H. N. lib. 37. Athanase Kirchner seems to have been the first to observe them in marble, jasper, and agate-stone. Very interesting is what Pliny says (l. c.) about an agate belonging to king Pyrrhus, on which Nature has sculptured the figure of Apollo with his cithara, attended by the nine Muses, and on which, by a certain tracery of stains, the instruments of all the Muses were reproduced. See 'Disputatio M. Jo. Jacobi Lungershausen,' held at Jena, about the figured imitations of nature, showing many beautiful phenomena of agates.

"§ VI. Those marbles, which are very elegantly coloured, represent to our fancy various figures, as may be seen in many very curious specimens; they are, therefore, largely dug in our neighbouring principality of Idstein, where they adorn sacred as well as profane buildings, from the pavement to the roof. Not less interesting, and not yielding in interest to the above, whether we look at the most elegant pictures they produce, or whether we consider them as a plentiful supply of coloured marble, are the specimens which were lately communicated to us by a friend from the principality of Diz, and which we may recommend as particularly deserving the notice of our readers, the first three, fig. 1, 2, and 3, drawn correctly from the originals. The fig. 1 represents an entire human head, together with all other parts of the body, not inelegantly drawn. The fig. 2 represents a head of an OWL (see Pl. XXII. Fig. 1, *nobis*); and the fig. 3 a view of a country, which is but a mere play (artifice) of nature. With regard to the latter it may perhaps not be unsuitable to compare what D. D. Behrens in his 'Hercynia Curiosa,' p. 134, titl. xiii. says, about the quarry called the 'map-stone.' It is as follows:—'This stone is found in the quarries of the villages Petersdorff and Rudigers- or Riddigers- Dorff belonging to the Count Stollberg's estates at Hohestein or Neustadt, and the name of 'map-stone' was given to it because the veins of this stone bear in the most part the appearance of rivers as traced on maps.'"

The original runs thus:—

"§ IV. Quo vero eo melius hæc nostra figurata ab omnibus ac singulis intelligi queant et ut omnis eo facilius inter illa evitetur confusio; operæ pretium facturos nos putamus, si relictis aliis spinosis et futilibus circa illorum productionem oberrantibus opinionibus, cum hic quilibet suo videatur abundare ingenio, ea dispescamus in duplicem classem, alia adscribendo mero accidentali NATURÆ LUSUI, alia e contra a DILUVIO illo UNIVERSALI, quo totam terram obrutam omnesque ejus excelsos montes aquis opertos fuisse, ex paginis sacris edocemur, Gen. vii. v. xix., derivando.

"§ V. Priori classi assignamus omnia ac singula illa corpora fossilia, quæ varias figuras, ut formicæ, scarabei, pavonis, piscium aliorumque animalium superficietenus tantum nobis exhibent, quod quidem frequentissime in lapidibus observari suo jam tempore docuit Plinius, H. N. l. 37. Præprimis huic negotio parere videntur Athanasio Kirchero Marmor, Jaspis et Achates. Memorabile sane est quod de Achate refert Plinius, l. c., quod videlicet Pyrrhoni Regi fuerit Achates, cui natura insculpserit Apollinem cum Cythara stipantibus novem Musis, certo Macularum ducta ita depictis ut simul instrumentum cujusvis Musæ emergeret. Vide Disput. M. Jo. Jacobi Lungershausen Jenæ habita de Imitamentis naturæ circa figuras, plura eaque egregia Achatis phænomena exhibens.

"§ VI. Marmora quoque elegantissime esse colorata variasque Phantasiæ nostræ obtrudere figuras, videre licet in variis speciminibus quæ passim ad curiosos transmittentur, et adeo copiose quidem in vicino nobis Principatu Idsteinensi eruuntur, ut illic sedes sacræ et profanæ iisdem a pavimento ad verticem usque splendescant. Minime vero his cedunt, sive frequenter in illis spectemus occurrentem elegantissimam picturam, sive uberrimum varie coloratum marmorum proventum, illa specimina quæ nuper nobis a singulari quodam amico ex Principatu Dizensi communicate sunt, et ex quibus Lectoris admiratione præprimis digna indicamus tria illa que fig. 1, 2, et 3, graphice et ad vivum delineata exhibent. Ex quibus fig. 1, integrum caput humanum cum aliis corporis humani partibus haud ineleganter repræsentat, fig. 2, caput Ululæ, et fig. 3, Tabulas Regionum sive sane Naturæ artificio sistit. Cum tertio non incongrue fortassis conferendum quod D. D. Behrens nobis describit in Hercynia sua curiosa, p. 134, tit. xiii., 'Von dem Steinbruch der Land-Karten-Stein genant,' hunc in modum: 'Dieser Steinbruch ist nahe bei denen uns benachbarten in den Hoch-Gräfflichen Stollbergischen Amt Hohestein oder Neustadt gelegenen Dörfern Petersdorff und Rudiges- oder Riddiges-Dorff genant anzutreffen, und hat den Namen daher bekommen, weilen die Adern dieses Steines in grossen Stücken, wie die Flüsse in denen Land-Karten ein Ansehen haben.'"

We really seem to have the record of a true fossil, although the statement is mixed up with the wonderful tales of Agricola and Albinus, in the 'Piscium et Querelæ et Vindiciæ, expositæ a Johanni Jacopo Scheuchzero, Med. D. Acad. Leopoldin. et Soc. Reg. Anglicæ ac Prussicæ Membro,' pp. 14, 15.—Tiguri, 1708. See figure in plate ii. (copied in Pl. XXII. Fig. 2, *nobis*).

We had rather, however, the Doctor should speak for himself.

"Behold also, a tail of a bird, or a remige-feather, in the fissile stone of Oeningen, the only specimen hitherto known of the remains of the winged kingdom except the gallinaceous bird quoted by Agricola in his Foss. 4. x. p. 371, in concurrence with the image of a bearded Roman Pontiff, wearing on his head the triple crown; the existence of which latter is however questionable, the more so, as in the public Records of Eisleben no mention is made about it, according to Cl. Don. Gothofr. Mylii Memorab. Saxon. Subterr. p. 5; yet it must have been so, as the stone not long after the Reformation, about the year 1539, was presented, first to Luther, and then to Francis I., King of rance. Moreover, according to Albinus, p. 105, it is said, that the mage of the Pontiff was adorned with a triple crown, and the ponti-ical robes were of tissue made of gold-like and purple thread, and he human eyes, ears, and nostrils, distinctly shown; the figure of he Pontiff sitting in a splendid chair, raising his right hand, on which ven a jewel (*St. Peter's ring*) could be observed.*

The original text is:—

" Ecce enim CAUDÆ *avis* vel REMIGEM *pennam* in Lapide fissili Onin-ensi conspicuam, unicum, quod hactenus fit cognitum ex Volucrium Regno uperstes monumentum. Excipite *Gallum Gallinaceum*, cujus meminit Agric. 4, x. *Foss.* p.371, jnxta Pontificiis Romani *barbati et triplicem coronam capite habentes effigiem*, de cujus tamen existentia merito dubitatur, quan-oquidem in Actis Publici Eislebiensibus ne minima quidem fiat mentio, este Cl. Dn. *Gothofr.*, *Mylio Memorab. Saxon. Subterran.* p. 5, fieri autem lebuisset Lapidis et non longe post Reformationem, anno nimirum 1539 ruti, dono dati primum *Luthero* postea Francisco I. Galliarum Regi; ræsertim si, quod *Albinis* scribit p. 105, *Pontificis effigies* ad fuit *rnata* triplici corona *et veste* Pontificiali, aureis quasi filis et purpura con-exta, *os, oculos, et nares hominis, referens, in sella splendida sedens, de-ique dextram manum sublevans, inquam tanquam gemmam contemplans stuebatur.*"

It is difficult to know what Mylius (1709) means in the following passage:—

" I am bound to mention also that in the same quarry (Illmenau), a few years ago, a model has been discovered, which presented a HEN very distinctly reproduced, and which is the more remarkable as even the intestines of the hen were imprinted."

He follows these remarks with others about fish-remains, which are more likely to have been true fossils:—

" Ich muss auch ferner mitberühren, dass eben in diesem Wercke, vor wenigen Jahren noch, eine Niere, in welcher eine Henne ganz deutlich abgebildet war, gefunden worden, so um desswillen *remarquabel*, dass dieses Bergwerck diese Henne in seinen innersten Eingeweide exprimiret."†

Buttner, in his 'Rudera Diluvii Testes' (1710), says that "near Lubeck, there was once discovered a petrified branch of a tree, together with a bird's nest. A petrified twig, very nicely formed, is also shown in the Museum of Arts at Florence."

Further on is another passage:—"To this happy circumstance (*i. e.* a communication from the Pastor Webel) I owe also a confirmed assurance respecting a bird's nest discovered *there* (*i. e.* near Kindelbrück, in Thuringia), together with four or five white eggs (like quails' eggs), and a stone four yards round,‡ which was very firm, and a *figure* of which was shown to me by another friend, as represented on plate xxi. fig. vi." (see Pl. XXII. Fig. 3, *nobis*).

* In the British Museum copy the plate containing the figure of the bird from Œningen is wanting.

† Mylius, 'Memorabilium Saxoniæ Subterraneæ,' Leipzig, 1709, p. 47.

‡ Literally, " 4 *Ellen starck*."

We give the text of these passages:—

"Bei Lubeck wurde einst ein versteinter Ast mit einem Vogel-Nest gefunden. Ein versteinter Zweig, gar artig proportionirt, wird in der Kunstkammer zu Florenz gewiesen," p. 187.

"Eben bei diesem glücklichen Zuspruch bekomme nochmahlige Versicherung, wegen eines daselbst gefundenen Vogel-Nests, darinnen 4 oder 5 weisse Eyer, als Wachtel-Eyer, und ein Stein der 4 Ellen starck und sehr feste gewesen gelegen, welches mir von einem andern Freunde vorgebildet worden als Tab. xxi. weiset." [M. D. S. Buttner's 'Rudera Diluvii Testes,' p. 218, pl. xxi. fig. 6.—Leipzig, 1710.]

"I cannot present now," says M. Hermann, in his 'Maslographia'* (1711), "all the figures which I possess on my polished pyramids, squares, and other big stones, but I will, nevertheless, give a few of them, plate xiii., from R. 12 to 17, as they are in a polished state." It is unfortunate for us M. Hermann could not do all he evidently wished, but for our purpose he has done quite enough, and we copy his fig. 17 (in our Pl. XXII. Fig. 3), as it has been referred to amongst the statements of bird-remains.

Hermann also gives in tab. xi. fig. 99 another figure, which we also copy, describing it in his text as "a white stone with the neck of a goose" (see our Plate XXII. Fig. 8).

"Fig. 99. Lapis albus cum collo anserino. Ganss-Hals."

(To be continued.)

CORRESPONDENCE.

Homo sapiens versus *Pithecus indocilis.*

Sir,—Page 392 of your periodical for October, contains an allusion to the Andaman Islanders. The subjoined extracts from the 'Friend of India,'† of the 6th August last, may perhaps tend to show that their degraded condition is more to be attributed to the circumstances attending their mode of existence (*toto orbe divisos*) than to any natural deficiency of intellect in them; that their apparent low condition, relatively to the rest of mankind, is owing to deficiencies which are more acquired from the circumstances which have surrounded them hitherto than inherent in themselves. W. T. N.

Extracts.—"Never, we venture to say, has the Government of India published such remarkable documents as a Report by Lieutenant-Colonel Tytler, with a narrative, by the Rev. Henry Corbyn, of attempts to civilize the pigmies who inhabit the Andaman Islands." . . . "Mr. Corbyn declares he has unquestionable proof that the Andamanese, who are 'most imitative and possessed of extraordinary memory and quick intelligence, may soon acquire our language;' and he speaks of 'the submissive and

* The title of this work is,—"Maslographia, oder Beschreibung des Schlesischen Massel, im Oelfs-Bernstädtischen Fürstenthum mit seinen Schauwürdigkeiten. Von Leonhard David Hermann. Brieg. 1711."

† One of the first newspapers in the East.

orderly conduct, good temper, and the pleasure evinced by the twenty-eight inhabitants of the Home.'" . . . "We would commend Mr. Corbyn's narrative to the study of those who, like Sir W. Denison, enter the lists in a mild fashion against Mr. Darwin and Professor Huxley, in defence of the dignity of the race and its generic difference from the gorilla. If Mr. Corbyn's record is to be trusted, the fact that the most degraded specimens of humanity yet discovered can be taught in a few weeks to show extraordinary memory 'and quick intelligence,' to distinguish the letters of our alphabet and read words of two syllables, will not be overlooked by those who hold the old-fashioned belief that God made man in His own image."

Southampton, 3rd October.

Mr. Guppy's Article on Trinidad Rocks.

MY DEAR SIR,—I am very sorry to see by your last number that Mr. Guppy has most unaccountably misapprehended the tenor and purpose of my former letter to you. I was perfectly aware that Mr. Guppy was not the authority for the correlation of the beds in question with the Neocomian of Europe; nor do I for one moment raise any objection to the connection of the two series of rocks. I merely objected to the use of the term "age;" and without dissenting in one particular from Mr. Guppy's statements, took the opportunity of referring to Professor Huxley's views on "homotaxis." Your correspondent himself states that he has held views similar to those in question; and I am, therefore, surprised that he should have troubled himself to enter into an explanation on other matters, which was alike unnecessary and uncalled for.

Let me assure Mr. Guppy that I concur in all that he has written on this matter, saving the one word "age;" and I am sorry that he should have thought it worth while to correct an error which had no existence but in his own imagination. Yours truly,

E. R. LANKESTER.

8, *Savile Row, W.*

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

LIVERPOOL GEOLOGICAL SOCIETY.—The abstracts of the proceedings of this useful society, for the sessions of 1861-2 and 1862-3, have just been printed; they commence with the Report of the Excursion to Holywell on the 11th July, 1861.

The mountain limestone of that neighbourhood contains many species of the ordinary fossils in profusion,—*Productus giganteus*, *P. semireticulatus*, *Lithostrotion basaltiforme*, and *Syringopora geniculata* being the most common. The formation is there divided into the following subdivisions:—1, numerous beds of Chert; 2, Shale and Limestone, with concretions of chert; 3, Black Limestone; 4, White Limestone. The position of the chert nodules in No. 2 is similar to that of the flints in the Chalk, but their form is different, being round flat concretions, thick in the centre, and gradually thinning towards the circumference.

Next follows the Report of the Excursion to Coalbrookdale, on July 31st.

The excursion occupied two days, which were devoted to examining the Silurian strata. The low land to the west of Coalbrookdale, towards Buildwas, is Wenlock Shale; the lofty ridge, including Benthall Edge and Lincoln Hill, is Wenlock Limestone, with the millstone-grit and coal-measures reposing thereon. The following fossils were collected upon the occasion, from the Wenlock Limestone:—*Heliolites Murchisonii, H. megastoma, Propora tubulata, Favosites Forbesii, F. cristata, F. fibrosa, Lebecheia conferta, Halysites catenularia, Syringopora bifurcata, S. fascicularis, Thecia Swindernana, Cyathophyllum articulatum, Omphyma Murchisonii, Aveolites Grayii, Cystiphyllum sp., Calymena Blumenbachii, Athyris tumida, Rhynchonella sphærica, R. nucula, R. borealis, Atrypa marginalis, A. reticularis, Strophomena depressa, Euomphalus rugosus, E. discors, E. sculptus, E. funatus, E. carinatus*; from the Wenlock Shale; *Encrinital Stems, Calymena tuberculosa, Lingula sp., Orthis hybrida, O. biloba, O. elegantula, Rhynchonella sp., Leptena transversalis, Acroculia?* Crustacea are rare at Coalbrookdale, when compared with the same formation at Dudley.

Amongst the papers printed, are "On the Inferior Oolite," by the Rev. S. H. Cooke, M.A. The Inferior Oolite, as developed among the Cotteswolds, especially near Cheltenham, consists of four chief divisions,—1. Ammonite Sands, about forty feet thick, by some considered to belong to the Upper Lias, but probably a transition bed between that and the Inferior Oolite. *Rhynchonella cynocephala*, and many Ammonites are peculiar to it. The best sections are to be seen at Frocester and the Haresfield Hills. 2. Pea-grit or Pisolite, about forty feet in thickness, confined to the immediate neighbourhood of Cheltenham. 3. Freestone and Oolitic Marl series, about one hundred and ninety feet thick at Leckhampton Hill; the freestone is much quarried for building, but generally unfossiliferous. The Oolite marl-bed, about seven feet thick, contains many fossils. Near Stroud it contains a thin coral reef, with Nerinæa. 4. Ragstone, about thirty-eight feet in thickness; a hard gritty rock, with many fossils. It is subdivided into Gryphite-grit, Trigonia-grit, and Pholadomya-grit. The first of these exclusively affords *Gryphæa Buckmannii*, which is also found in the Swiss Jura and Swabia; Chemnitzia, Pholadomya, and Gresslya abound in this division. It maintains a nearly constant thickness over the whole district, while all the inferior divisions, including the Upper Lias, thin out and gradually disappear towards the east and south-east. Thus, at Stonesfield the Ragstone is thirty feet thick, while all intermediate strata between it and the Upper Lias are omitted; the latter is six feet, resting on the Marlstone twenty-five feet. The Inferior Oolite is also developed near Dundry, where the chief fossiliferous bed probably corresponds in place with the Cheltenham Pisolite; also in Dorsetshire, near Bridport, where it forms the coast-section, but is much disturbed by faults. Its fauna in these more southern localities differs much from the Cotteswoldian, the Bristol coal-field having formed a complete barrier between. It is also developed on the Yorkshire coast, near Scarborough.

"On the Stonesfield Slate, and its associated Strata." By Mr. W. S. Horton. The term Stonesfield Slate is applied to a bed which forms the base of the Bath Oolite in certain localities of the counties of Oxford, Gloucester, and Northampton. It is typically developed at Stonesfield, near Woodstock, and consists of a finely laminated calcareous sandstone, and although of very inconsiderable thickness, rarely exceeding one foot, was formerly of considerable local value for roofing-purposes. It is not exposed in open quarries, but worked by means of shafts and galleries, the latter extending to a considerable distance from the mouths of the pits. The blocks of slate when first raised are very compact, but after being exposed to the action of frost split readily along the planes of bedding. The organic remains are numerous and varied, including several orders of plants. The plants are for the most part terrestrial, and include such forms as Pterophyllum, Zamia, and Sphenopteris. The small extreme branches of coniferous shrubs allied to the cypress and yew, which have received the name of Thuytes, occur also. Several genera of insects are among the rarer fossils. The Mollusca are but limited in species. The fishes of Stonesfield belong entirely to the Placoid and Ganoid orders. The remains of this kind are palatal teeth of the genera Strophodus and Pycnodus, teeth of Hybodontidæ and Sauroidei. The most famous of the Stonesfield reptiles is the *Megalosaurus Bucklandi*. There is also one species of Teleosaurus, and one of Pterodactyle, and one small species of Chelonia. The remarkable catalogue of associated life exhibited by this formation is rendered still more complete by three genera of small Mammalia. The Northamptonshire equivalent of this bed is a deposit of ferruginous sand and ironstone, termed Northampton sand. It is worked as an iron-ore near Blisworth. Its fossils are very scarce, and for the most part fragmentary; those from the Duston pits being the only ones that are sufficiently well preserved for identification. From the fact of this Northampton sand resting on the Upper Lias without any intervening beds, some geologists have been disposed to regard it as the equivalent of the Upper Lias sand of Gloucestershire, but the author considers the evidence not to be in favour of this opinion, as all the species hitherto collected are identical with those of the Stonesfield Slate.

"On a Fossil Elytrum from the Stonesfield Slate." By Mr. C. S. Gregson. The author stated that this wing-cover could not be referred to Buprestidæ, but is undoubtedly a Longicorne, and nearly allied to, though not identical with, *Prionus coriarius* of the present day, which has the elytra roughly punctured and three obscure raised lines, whilst the specimen under consideration has the whole surface divided equidistantly with more deeply sunk lines, and one well-defined mark on the side, carried down to the end of the wing-case. Specimens from South America so nearly approach the fossil in form that the author thought it advisable to give it the provisional name of *Prionaroides Hortoni*.

"On the Surface Markings near Liverpool, supposed to have been caused by Ice." By G. H. Morton, F.G.S. Towards the end of 1859 the author gave an account, to the Literary and Philosophical Society of Liverpool, of certain indications of ice passing over and grooving the rocks in Toxteth Park. Since that time he has found the same appearances in two other places. The following are the three localities:—In a field between Park Hill Road and the Dingle; in the brickfields, about 50 yards north of Boundary Street and 150 yards west of Gore Street, where about 10 yards of striated surface have been exposed for some years. The Sandstone belongs to the base of the "Keuper" formation. The surface inclines about 5° in the same direction as the grooves and furrows, N. 15° W. The elevation above the sea is about 80 feet. The other locality is also in the brickfields, about 600 yards S.W. of Kirkdale Gaol, and about the same distance from that last referred to, with which it may possibly communicate. The Sandstone belongs to the base of the "Keuper," and the striated surface exposed is fully 500 square yards, inclining throughout at an angle of 7½° in the direction of the striæ, which is the same as in the contiguous example, N. 15° W. The elevation above the sea is 80 feet, or perhaps a little less.

Since this communication was read, the author has found very distinct ice-grooves at Oxton, Cheshire, half a mile S.E. from the telegraph on Bidston

Hill. The direction of the striations is N. 30° W., and the elevation *about* 120 feet above high-water level.

"On the Thickness of the Bunter and Keuper Formations in the Country around Liverpool." By G. H. Morton, F.G.S. The author gave the results of recent measurements of the Triassic strata around Liverpool, and exhibited a section of the Keuper Sandstone of Storeton and Wapping tunnel. The following shows the results that he had obtained:—Keuper formation—Red Marl, 100 feet; Upper Shales, or Waterstone, 75 feet; Upper Sandstone, red and yellow, 150 feet; Lower Shales, 50 feet; Lower Sandstone, yellow and white, with conglomerate base, 175 feet: Bunter formations—Upper soft yellow Sandstone, 100 feet; Upper soft red and variegated Sandstone, 300 feet; Pebble-beds, 350 feet; Lower soft red and variegated Sandstone, base yellow, 400 feet; total, 1700 feet. The Upper Shales may be above 75 feet; that is the apparent thickness. The Lower soft red and variegated Sandstone may possibly exceed 400 feet, for its actual base is not seen.

Obituary Notice.

THE REV. STEPHEN HISLOP,

OF NAGPUR.

We sincerely regret to see a paragraph in the newspapers announcing the decease of the Rev. Stephen Hislop, of Nagpur, Missionary of the Free Church of Scotland, who was drowned, near Nagpur, on the evening of September 4th of this year. He was not only a highly esteemed Christian minister and most amiable man, possessing great influence with the natives of Central India, but he was also a good geologist, hard-working, clear-sighted, and cautious.

Several years ago (1853) the Rev. S. Hislop and his then colleague, the Rev. R. Hunter, observed that the tablets of reddish sandstone that served the native school-children for "slates" bore fossil remains of plants; and tracing the stones to the quarry from which they were obtained, they discovered abundant vegetable fossils; and, collecting them with care, they sent a large series of specimens to the Geological Society of London, most of which have been since described (in 1861), by Sir C. Bunbury, in the Society's Journal. They also made a careful examination of the geological characters of the vicinity of Nagpur, collected all the information they could from memoirs and notices by early labourers in Indian geology, and sent a large collection of Tertiary plant-remains, shells, insects, fishes, and bones, as well as rock-specimens and minerals, from the Nagpur territory to the Geological Society. Before long, in 1854, Messrs. Hislop and Hunter communicated to that Society a memoir, giving their views as to the geological structure of that country; and an abstract was published in the tenth volume of the Geol. Soc. Quart. Journ., and the memoir, in full, appeared in the eleventh volume, with a geological map of the western part of the Nagpur territory by the authors. Amendments of the map were subsequently communicated by Mr. Hislop; and in 1855 he sent home a short notice on the Umret Coalfield, lying north of Nagpur, and related by synchronism to the plant-beds of the latter district, as well as to the Burdwan and other coals of Bengal. Having come to England, in 1859, Mr. Hislop undertook the description of the Tertiary shells that he ıd Mr. Hunter had formerly sent home, as well as others that he now rought, both from the vicinity of Nagpur and from Rajamandri; and the esults of this labour of love appeared as a memoir in the 'Journal of the eological Society,' vol. xvi., illustrated with six plates, chiefly from his wn drawings. The fossil insects and Cypridæ of Nagpur were at the ame time described by his friends A. Murray, F.R.S.E., and Rupert ones, F.G.S.

Returning to India early in 1861, he wrote a succinct account of his views f the age and relationship of the red sandstones, coal, and other beds of entral India, on board the steamer, and communicated it to the Geo- ogical Society as a companion paper to Sir C. Bunbury's memoir on the ossil plants of Nagpur and Mangali, both appearing in the seventeenth olume of the Society's journal. Later in the same year an extract from ne of his letters appeared in the same journal (vol. xviii.), on the age of he Kotah limestone, which lies on sandstone containing plant-remains, nd equivalent to that near Nagpur.

Mr. Hislop had also communicated the results of his geological re- earches to the Bombay Asiatic Society's Journal; his latest memoir in hat work, we believe, is in vol. vi.

The results of the geological labours of our deceased friend are of much mportance in the natural history of Central India, and, indeed, throw ight on the age of the coal-series of Bengal also. The great fern-leaves, tems of trees, and other plant-remains from near Nagpur; the plants and eptiles, fishes and Estheriæ from Mangali; the Ceratodi from Maledi; he fishes and other fossils from Kotah, as well as the manifold fossil orms from the Tertiary beds of the Deccan, all help, or will help, in indi- ating the relative ages of the Indian strata, and putting them in geolo- ical order, adding knowledge for the scientific geologist, and, thereby, uidance for the practical man.

The earnestness and clearness of his work, whether in the field or at home, rere equalled by Mr. Hislop's desire to be just to fellow-labourers and arlier observers, and by his modest avoidance of notoriety as a geologist nd naturalist. With his equally enlightened colleague he had gleaned nuch in the Nagpur field of natural history, and when, after the Indian ebellion (during which a friendly native warned him in time to save Nagpur from the threatened evil), he lost his colleague,—retiring with roken health,—he still gave all the leisure that he conscientiously could pare from his more important duties to collecting and observing, his eriodical tours of inspection and instruction affording almost his only pportunities. A faithful native, Vira, served him as a collector, being ccasionally sent to considerable distances for fossils. At one of Vira's ast visits to Maledi (1863), he discovered a valuable series of reptilian ones and teeth.

As helps in studying the fossil forms of life in India, Mr. Hislop lost o opportunity of collecting and observing recent animals and plants of kinds similar to the extinct; and these he freely communicated to natural- sts in India and England. Some small bivalve Crustacea collected by him from the ponds and streams of Nagpur have been described by Dr. Baird, and allied fossil forms from Naghur and Mangali by Mr. Rupert Jones.

Taken away suddenly from his family, his friends, and his native church and schools, he will live in our memory as a beloved man, just and good, and as an acute observer, cautious and conscientious; not courting praise, nor even notice, but delighting in work and truth as a loving student of nature and a faithful servant of God. T. R. J.

FOREIGN INTELLIGENCE.

The question of the "Terrain Quaternaire" and the antiquity of man in the north of France, discussed at the Academy of Sciences on the occasion of the discovery of the human jaw at Moulin-Quignon, has been treated in detail by M. d'Archiac in his Museum lectures, now collected and published by M. Trutet. M. d'Archiac does not share in the opinion of M. Elie du Beaumont upon the general question of the degree of antiquity of the human species, and relatively to the special case of the Moulin-Quignon jaw, he does not support the opinion of the learned Perpetual Secretary of the Academy as to the nature of the deposit. He believes there is nothing in the least to justify the assertion that it is one of those which come within the denomination of "meubles sur les pentes." The deposits on the declivities, if they are due to floods and torrential waters, display a particular structure, and require hollows in the soil which do not exist in that district, and those which might be attributed to occasional erosions of the rivers do not accord with the lines of ancient talus, but on the contrary, with common modern deposits. Moreover, the analogy of the deposit at Moulin-Quignon with those of other neighbouring localities incontestably quaternary does not permit a separation. The discovery of the human jaw of Moulin-Quignon, whatever its authenticity, has in reality but a secondary importance; it is a simple fact confirming proofs of much greater value by their number and generality. If the worked flints cannot really be attributed to chance, if they are really the produce of human industry, if they can be regarded as the evidence equally indisputable, of the existence of man before the formation of the deposit which contains them,—as the bones of elephants, rhinoceros, the great deer, hippopotamus, bear, hyæna, cave-lion, etc., are of the contemporary existence of those animals,—it matters little whether we meet with, or do not meet with the remains of man himself; the question is resolved by the fact, and it matters little primarily whether the sand and the solid gravel of Moulin-Quignon be or be not quaternary. The general essential result, the theoretical point which governs the question, namely, the antiquity of man and his contemporaneity with the great extinct species of mammifers, would not be affected, and the conclusion would lose nothing of its value from being founded on the produce of human industry, instead of upon the remains of man's skeleton. Regarding the facts acquired, we cannot refuse to admit that the worked flints of Amiens and Abbeville are found in a deposit essentially quaternary, associated with the bones of animals of extinct species, and except from particular circumstances there is no reason to suspect the human jaw of Moulin-Quignon should not be contemporary. Now however it remains to treat an essential point—the precise determination of the age of those deposits or the place they occupy in the quaternary series. This determination M. Archiac thinks very easy. Not by seeking on the South terms of comparison where none exist, or of which, if they did, we could not admit the value, but by going to the North-west in the Low Countries where the quaternary series above and below the level of the sea is to be seen in its true relations with the Upper Tertiary deposits; or, better still, to the north in the eastern counties of England. In the particular basin of the Somme, as in all the little depressions which follow the watercourses which run from the divisional line of the Oise directly to the sea, the deposits of transported detritus, ooze (*limoneux*), sand, and gravels repose directly on the Chalk, excepting where the

Lower Tertiary deposits separate them, and we perceive no intermediate stratum sufficiently characterized to admit our appreciating the immensity of time which elapsed before these recent sediments were superposed. But beyond that district the original flint-implement stratum, identical with that of the valley of the Somme, is found in the lacustrine beds which have succeeded the partial scooping out (*ravinement*) of the till or boulder-clay. The evidence of these relations has been given by the sections at Hoxne, in Suffolk, the valley of the Lark, at Bedford, etc., compared with those of Mundesley, on the Norfolk coast. These have demonstrated to us that the lacustrine beds are more recent than the marine quaternary deposits of England, Scotland, and Ireland, and still more so than the Norfolk Crag, the masses of bones of *Elephas meridionalis* and *E. antiquus*, and lastly than the phenomena of striation, groovings, and polished surfaces of the northern regions, whether in the British Islands or in Scandinavia. The fauna which characterizes these sediments, where industrial products for the first time appear, consists of fluviatile and terrestrial mollusca,—which, with two or three exceptions, still live in the district,—and of pachydermatous mammalia, ruminants, and carnivora—*Elephas primigenius*, *E. antiquus*, *Rhinoceros tichorhinus*, *Hippopotamus major*, *Cervus tarandus*, *C. megaceros*, *Bos primigenius*, *B. moschatus*, *Equus fossilis*, *Felis spelæa*, *Hyæna spelæa*, *Ursus spelæus*, etc.; that is, precisely the association of species which we find in the fluvio-marine deposits of Menchecourt, in the sand and gravel drift deposits (*terrains de transport*) of other localities around Abbeville, Amiens, as well as in the valley of the Oise, in the environs of Chauny, etc. The analogy of these faunas, between one part and the other of the region, is rendered still more striking by the presence at Menchecourt of the *Corbicula consobrina* or *fluminalis*, so characteristic of the same horizon from Grays Thurrocks, on the left bank of the Thames, as far as the neighbourhood of Hull, on the borders of the Humber, and which has been observed at the same horizon in well-sinkings at Ostend.

Now the débris of this fauna of vertebrates and invertebrates has been buried since the spreading of the great deposits of sand, clay, and rolled pebbles, which extends from the east and south parts of England, and to which succeeds also, in some parts of the Continent, an argillaceous sand analogous to the ancient alluvium. If with these known stratigraphical and palæontological divisions on the other side of the straits, we specially compare those of the valley of the Somme, we shall be led to regard the quaternary deposits of the latter as not more ancient than the lacustrine beds of England, as contemporary with those that beyond the Channel contain the fauna of great extinct mammalia which lived towards the middle of the Quaternary epoch. The deposits of the valley of the Somme, like those of the basins of the Oise, more recent than the boulder-clay (*argile à blocs*), than the crag of Norfolk, represent, in reality, only the phenomena which preceded the second glacial period. Thus on the one part the comparison of these deposits with those of the neighbouring departments to the east, and where the stratigraphical relationships are better marked, permits a statement of the period to which they belong; on the other hand, their comparison with those of Belgium, Holland, and England, reveals their true place or exact horizon in the series of sediments of this age. "We distinguish thus," says M. d'Archiac, "with M. Worsaae, two ages of stone; one anterior to the last quaternary deposits, or *antediluvian*, characterized by the most rudely worked flints; the other, posterior or *antehistoric*, the arms or instruments of which belong to a more or less barbaric state, the age of which comes up

to the ancient peoples of Denmark, who formed the Kjökkenmöddings, and those of Switzerland, Ireland, and other regions, who constructed their lake-dwellings."

M. Raynal, Professor of Physics at Poitiers, has discovered the remains of a crocodile in the oolite of Grand-Pont. The lower jaw is like that of *C. Schlegelii* of Blainville (Ostéog. p. 5, pl. ii.). The opercular bones extend as far as the symphysis, a character unknown in any other crocodile. In allusion to these conditions, the specimen has been termed *C. physognathus*.

NOTES AND QUERIES.

MAMMALIAN REMAINS.—The following passage in Bishop Gibson's translation (ed. 1772) of Camden's 'Britannia,' seemingly refers to Mammalian remains, and possibly to fossil flint implements:—" After the Wye has run a little further and saluted Goodrich Castle, which King John gave to William, Earl-Marshal, and which was afterwards the principal seat of the Talbots, it takes leave of Herefordshire, and goes into the county of Monmouth. In the south limit of this county is Doward, in the parish of Whitchurch, a pretty high hill, on the top whereof one would guess by the ditches that there had been an ancient fortification; and what makes it probable is that in digging there for iron-ore and limestone, *broad arrow-heads* have been found of late years, and not long ago the greatest part of the *bones of a gigantic person* were found here interred in a place which seemed to be arched over: the length of all the joints was twice the length of others of this age, and they were given by two neighbouring gentlemen, Captain Scudamore and Mr. White, to a surgeon in Bristol."

PROFESSOR R. JONES ON FORAMINIFERA.—For the 6th paragraph on page 294, and the second footnote, substitute the following:—

Fig. 9-11. ROTALIA* UMBILICATA, *D'Orbigny*, sp.

This is a small compact variety of *Rotalia Beccarii*, and is almost, if not quite, the same as *Rotalia Soldanii*. *R. Beccarii* lives in rather shallow water, and some of its varieties live in very shallow water, even in river-mouths and salt-marshes; whilst *R. umbilicata* is found in deeper water than the type lives in; and *R. orbicularis*, another variety, is smaller still, and exists in deeper parts of the sea, from a hundred to a thousand fathoms.

MISCELLANEOUS NOTICES.

'Silliman's Journal' for July contains "Observations upon some of the Brachiopoda, with reference to the genera *Cryptorella*, *Centronella*, *Meristella*, and allied forms," by Professor James Hall; continuation of the "Flora of the Devonian period in North-Eastern America," by Dr. J. W. Dawson; "New Facts and Conclusions respecting the Fossil Footmarks in the Connecticut Valley," by Edward Hitchcock; "On Aerolites and the fall of Stones at Butsura, India, May, 1861," by Professor N. S. Maskelyne. The new works or works preparing for publication noticed are, Annual Report of the State Geologist of California for 1862; Map

* For the description of *Rotalia* proper, see Carpenter's 'Introduction to the Study of Foraminifera' (Ray Society), 1862, p. 212, etc.

.y of St. Francisco; Map of vicinity of Mount Diablo; Map of Coast-s from Bay of Monterey south to Santa Barbara; Map of the hoe Silver-mining region; Map of Comstock Lode; Map of central on of Sierra Nevada; 'Ichnographs from the Sandstone of Connec- River,' by James Deane, M.D., 62 pp. 4to, with 45 plates; 'Notice me new species of Fossils from a locality of the Niagara group in na, with a list of identified species from the same place,' by Pro- r James Hall; 'Die Ctenodipterinen des Devonischen Systems,' by . H. Pander (St. Petersburg, 1858); 'Ueber die Saurodipterinen, lrodonten, Glyptolepiden, und Cheirolepiden des Devonischen Sys- .' by Dr. C. H. Pander (1860). The height of Mount Shasta, in ornia, has been fixed at 14,440 feet, by Mr. Whitney, the geological yor.

e September number of that journal has the following geological es:—"On the Coal-Measures of Cape Breton, N.B.," with a section, r. J. P. Lesley; "On the Genus Centronella," by Mr. E. Billings; Childrenite, from Hebron, in Maine," by Mr. George J. Brush; Meteoric Iron from Dakota Territory," by Dr. C. T. Jackson, of on. Amongst the notices of new works are—

ammenstellung der Statischen Ergebnisse des Bergwerks, Hütten- und Salinen-Be- in dem Preussischen Staate während der zehn Jahre von 1852 bis 1861. By E. s. Berlin, 1853.——Handbuch der Metallurgischen Hüttenkunde, vol. ii. By Kerl. Freiberg, 1863.——État présent de la Métallurgie du Fer en Angleterre. M. Gruner et Lan. Paris, 1862.——Berg- und Hüttenmännisches Jahrbuch der ergakademien Leoben und Schemnitz, und der k. k. Montan-Lehranstalt, Pribram teur. P. Turner. Vienna, 1863.——Die Fortschritte der Metallurgischen Hüt- erbes im Jahre 1862. By Dr. C. F. A. Hartmann. Leipzig, 1863.——Inter- al Exhibition of 1862, Jurors' Report of Class I., Mining, Quarrying, Metal- and Mineral Products. By W. W. Smyth, F.R.S. London, 1862.——Second l Report upon the Natural History and Geology of the State of Maine. 1862. hed 1863.——Fossil Crustaceans from the Coal-Measures and Devonian Rocks of America. By Mr. Salter. In Q. J. Geol. Soc., vol. xix.——On the Cambrian Iuronian Formations. By Dr. J. J. Bigsby. In Q. J. Geol. Soc., vol. xix.—— Lower Carboniferous Brachiopoda of Nova Scotia. By T. Davidson, Esq. In Geol. Soc., vol. xix.——On the Fossil Estheriæ and their Distribution. By Pro- T. Rupert Jones. In Q. J. Geol. Soc., vol. xix.——On a new Labyrinthodont , *Anthracosaurus Russelli*, from the Lanarkshire Coal-Field. By Professor T. xley. In Q. J. Geol. Soc., vol. xix.——On the Production of Crystalline Lime- by Heat. In Poggendorf, Ann., vol. cxviii.——On the Flora of the Devonian in North-Eastern America. By Dr. J. W. Dawson. In Q. J. Geol. Soc.,

'Dublin Quarterly Journal of Science' for October contains a very sting "Description of the Tonymore Crannoge," by Mr. W. R. , with woodcut plans and views; a paper "On some Striated Sur- in the Granite near Dublin,' by the Rev. M. Close,—the striations ed to being on the vertical faces of joints, and resembling Slicken- ; a "Description of a New Species of Plesiosaurus from the Lias, Whitby," by Dr. A. Carte and Mr. W. H. Baily, with two plates, Plesiosaurus being the very large and perfect one found on the of the Marquis of Normanby, in July, 1848, in the Liassic beds of ettleness Alum Works, and presented by that nobleman to the late hilip Crampton, Bart., and now in the Natural History Museum of Royal Dublin Society. The name given to this specimen by the r is *P. Cramptoni*.

REVIEWS.

Air-breathers of the Coal Period; a descriptive account of the Remains of Land-Animals found in the Coal Formation of Nova Scotia, with remarks on their bearing on theories of the formation of Coal, and of the Origin of Species. By J. W. Dawson, LL.D., F.R.S., F.G.S., etc., Principal of M'Gill University, Montreal.

To Dr. Dawson geology is indebted for much progress in the knowledge obtained of the fossil botany of the Palæozoic period, but his discoveries of reptilian remains and of air-breathing land-shells in the coal strata of Nova Scotia, are discoveries in value far beyond the usual estimation of new species and genera. They are fixed points in the scale of progress in our science,—distinct steps in the ladder of human information; they teach important conclusions, and, rightly, their discoverer feels himself under an obligation to make them known as extensively and perfectly as possible to the scientific world. Although already the specimens have been more or less extensively illustrated in the pages of the 'Journal of the London Geological Society,' and have been submitted to the investigation specially engaged in the study of such remains, Dr. Dawson has found it impossible to bring out in this way all the details desirable, and to present a connected view of the facts. Hence the present publication, which is a revised reprint of articles published during the present year in the 'Canadian Naturalist and Geologist,' and illustrated with, besides the plates given in that journal, a photograph-plate of details of various Dendrerpetons and Hylonomi. Those who wish minutely to study this interesting subject, we must refer to Dr. Dawson's valuable *brochure;* but we may here well give a brief abstract of its contents, and in doing this we shall show a more marked appreciation of the doctor's labours than by any amount of laudatory comments we could bestow. The animal population of the earth during the older or palæozoic period is known to us chiefly through the medium of remains preserved in rocks deposited on the bed of the ocean, in which there is but slight chance of finding relics of the animals of the land, even if such had existed plentifully on its bounding shores. Perhaps for this reason—perhaps because there were no land-animals—the organic remains of the Cambrian, Silurian, and Lower Devonian rocks contain, so far as animal remains are concerned, only those of marine species. In the Upper Silurian and Lower Devonian, however, land plants begin to appear; and in the Upper Devonian these are so numerous and varied as to afford a great probability that animals also tenanted the land. Indeed, Mr. Hartt, of St. John, has informed the author of the discovery of insect-remains on the rich plant-bearing Upper Devonian beds of that locality. It is true, also, that reptiles of high organization have been found in beds referred to the Upper Devonian, at Elgin, in Scotland. That there was dry land even in the Lower Silurian period, we know, and can even trace the former shores. In Canada the old Laurentian coast extends for more than a thousand miles from Labrador to Lake Superior, marking the southern border of the nucleus of the American continent in the Lower Silurian period. Along a great part of this ancient coast are other sand-flats of the Potsdam sandstone, affording very favourable conditions for the embedding of land-animals, had such existed; still not a trace has been found.

"I have myself," says Dr. Dawson, "followed the Lower Silurian beds up to their ancient limits in some localities, and collected the shells which the waves had dashed on the beach, and have seen under the Silurian beds, the Laurentian rocks pitted and indented with weather marks, showing that this old shore was then gradually subsiding:

ret the record of the rocks was totally silent as to the animals that may have trod the hore, or the trees that may have waved over it. All that can be said is that the sun hone, the rain fell, and the wind blew as it does now, and that the sea abounded in iving creatures. The eyes of trilobites, the weathered Laurentian rocks, the wind-ripdes in the Potsdam sandstone, the rich fossils of the limestones, testify to these things. The existence of such conditions would lead us to hope that land animals may yet be ound in these older formations. On the other hand, the gradual failure of one form of ife after another, as we descend in the geological series, and the absence of fishes and and plants in the older Silurian rocks, might induce us to believe that we have here eached the beginning of animal life, and have left far behind us those forms that inhabit he land.

"Even in the Carboniferous period, though land plants abound, air-breathers are few, nd most of them have only been recently recognized. We know, however, with certainty that the dark and luxuriant forests of the Coal period were not destitute of animal ife. Reptiles crept under their shade, land-snails and millipedes fed on the rank leaves nd decaying vegetable matter, and insects flitted through the air of the sunnier spots. Great interest attaches to these creatures; perhaps the first-born species in some of their espective types, and certainly belonging to one of the oldest land faunas, and presenting rototypes of future forms equally interesting to the geologist and the zoologist.

"It has happened to the writer of these pages to have had some share in the discovery f several of these ancient animals. The coal formation of Nova Scotia, so full in its levelopment, so rich in fossil remains, and so well exposed in coast cliffs, has afforded dmirable opportunities for such discoveries, which have been so far improved that at east eight out of the not very large number of known Carboniferous land animals, have een obtained from it."

Five species of Carboniferous reptiles have been recognized on the continent of Europe, three in Great Britain, and four in the United States of America. Footprints were amongst the earliest indications of the Carboniferous reptiles of Nova Scotia:—

"It has often happened to geologists, as to other explorers of new regions, that footprints on the sand have guided them to the inhabitants of unknown lands. The first race ever observed of reptiles in the Carboniferous system, consisted of a series of small out well-marked footprints found by Sir W. E. Logan, in 1841, in the lower coal-measures of Horton Bluff, in Nova Scotia.

"The rocks of Horton Bluff are below the gypsum of that neighbourhood; so that he specimen in question (if Lyell's views are correct) comes from the very bottom of the oal series, or at any rate very low down in it, and demonstrates the existence of reptiles it an earlier epoch than has hitherto been determined; none having been previously ound below the magnesian limestone, or to give it Murchison's new name, the 'Pernian era.'

This important discovery, made in 1841, and published in 1842, has been overlooked by European writers:—

"And the discovery of reptilian bones by Von Dechen, at Saarbruck, in 1844, and hat of footprints by Dr. King in the same year, in Pennsylvania, have been uniformly eferred to as the first observations of this kind. This error Dr. Dawson desires to correct, not merely in the interest of truth, but also in that of his friend Sir William Logan, and of his native province of Nova Scotia; and he trusts that henceforth the received statement will be, that the first indications of the existence of reptiles in the Coal period, were obtained by Logan, in the lower coal formation of Nova Scotia, in 1841. Insects and arachnidans, it may be observed, had previously been discovered in the coal formation in Europe.

"The original specimen of these footprints is still in the collection of Sir William Logan. It is a slab of dark-coloured sandstone, glazed with fine clay on the surface; and having a series of seven footprints in two rows, distant about three inches; the distance of the impressions in each row being three or four inches, and the individual impressions about one inch in length. They seem to have been made by the points of the toes, which must have been armed with strong and apparently blunt claws, and appear as if either the surface had been somewhat firm, or as if the body of the animal had been partly water-borne. In one place only is there a distinct mark of the whole foot, as if the animal had exerted an unusual pressure in turning or stopping suddenly. The impressions are such as may have been made by some of the reptiles to be described in the sequel, as, for instance, by *Dendrerpeton Acadianum*.

"Attention having been directed to such marks by these observations of Sir William Logan, several other discoveries of the same kind were subsequently made, in various parts of the province, and in different members of the Carboniferous system. The first of these, in order of time, was made in 1844, in beds of Red Sandstone and shale near Tatamagouche, in the eastern part of Nova Scotia, and belonging to the upper or newer members of the coal-measures. In examining these beds with the view of determining their precise geological age, Dr. Dawson found on the surface of some of them impressions of worm-burrows, rain-drops, and sun-cracks, and with these, two kinds of footprints, probably of reptilian animals. One kind consisted of marks, or rather scratches, as of three toes, and resembling somewhat the scratches made by the claws of a tortoise in creeping up a bank of stiff clay; they were probably of the same nature and origin with those found by Logan at Horton. The others were of very different appearance. They consisted of two series of strongly-marked elongated impressions, without distinct marks of toes, in series four inches distant from each other, and with an intervening tail-mark. They seem to have been produced by an animal wading in soft mud, so that deep holes, rather than regular impressions, marked its footsteps, and that in the hind foot, the heel touched the surface, giving a plantigrade appearance to the tracks.

"Shortly afterward, Dr. Harding, of Windsor, when examining a cargo of sandstone which had been landed at that place from Parrsboro', found on one of the slabs a very distinct series of footprints each with four toes, and a trace of the fifth. The rocks at that place are probably of nearly the same age with those of Parrsboro'. Similar footprints are also stated to have been found by Dr. Gesner, at Parrsboro'. Dr. Dawson has since observed several instances of such impressions at the Joggins, at Horton, and near Windsor; these examples showing that reptilian animals existed in no inconsiderable numbers throughout the coal-field of Nova Scotia, and from the beginning to the end of the Carboniferous period. On comparing these with one another, it will be observed that Logan's, Harding's, and one of mine are of similar general character, and may have been made by one kind of animal, which must have had the fore and hind feet nearly of equal size. The other belongs to a smaller animal, which probably travelled on longer limbs, more in the manner of an ordinary quadruped. These impressions are chiefly interesting as indicating the wide diffusion and abundance of the creatures producing them, and that they haunted tidal flats and muddy shores, perhaps emerging from the water that they might bask in the sun, or possibly searching for food among the rejectamenta of the sea, or of lagunes and estuaries."

In 1851 Dr. Dawson discovered, in a large pile of rubbish, at the Albion Mines Railway Station in some blocks of hard carboniferous shale and earthy coal, scales, teeth, and coprolites. Observing an object of larger size than usual at the edge of a block, he split the block open and found a large flattened skull, which was dispatched to England, and after remaining a year or two as quietly in the Geological Society's collection as if in its original bed in the coal-mine, it was handed, in 1852, to Professor Owen, who described it in December, 1853, under the name of *Baphetes planiceps*, or the "flat-headed diving animal," in allusion to the flatness of the creature's skull, and the possibility of its having been in the habit of diving:—

"Of the general form and dimensions of Baphetes, the facts at present known do not enable us to say much. Its formidable teeth and strong maxillary bones show that it must have devoured animals of considerable size, probably the fishes whose remains are found with it, or the smaller reptiles of the Coal. It must in short have been crocodilian, rather than frog-like, in its mode of life; but whether, like the labyrinthodonts, it had strong limbs and a short body, or like the crocodiles, an elongated form and a powerful natatory tail, the remains do not decide. One of the limbs or a vertebra of the tail would settle this question, but neither have as yet been found. That there were large animals of the labyrinthodontal form in the Coal period, is proved by the footprints discovered by Dr. King in Pennsylvania, which may have been produced by an animal of the type of Baphetes. On the other hand, that there were large swimming reptiles, seems established by the recent discovery of the vertebræ of *Eosaurus Acadianus*, at the Joggins, by Mr. Marsh. The locomotion of Baphetes must have been vigorous and rapid, but it may have been effected both on land and in water, and either by feet or tail, or both.

"With the nature of its habitat we are better acquainted. The area of the Albion Mines coal-field was somewhat exceptional in its character. It seems to have been a bay or indentation in the Silurian land, separated from the remainder of the coal-field by a high shingle beach, now a bed of conglomerate.

"We may imagine a large lake or lagune, loaded with trunks of trees and decaying vegetable matter, having in its shallow parts, and along its sides, dense brakes of Calamites, and forests of Sigillaria, Lepidodendron, and other trees of the period, extending far on every side as damp pestilential swamps. In such a habitat, uninviting to us, but, no doubt, suited to Baphetes, that creature crawled through swamps and thickets, wallowed in flats of black mud, or swam and dived in search of its finny prey. It was, in so far as we know, the monarch of these swamps, though there is evidence of the existence of similar creatures of this type quite as large in other parts of the Nova Scotia coalfield."

The first discovery of the remains of a reptile, the *Dendrerpeton Acadianum*, and a land-shell in the interior of a great tree in the coal-measures of Nova Scotia, was primarily announced in a joint paper by Dr. Dawson and Sir Charles Lyell, before the Geological Society of London:—

"The South Joggins Section is, among other things, remarkable for the number of beds which contain remains of erect trees embedded *in situ*: these trees are for the most part Sigillariæ, varying in diameter from six inches to five feet. They have grown in underclays and wet soils, similar to those in which the coal was accumulated; and these having been submerged or buried by mud carried down by inundations, the trees, killed by the accumulations around their stems, have decayed, and their tops being broken off at the level of the mud or sand, the cylindrical cavities, left open by the disappearance of the wood, and preserved in their form by the greater durability of the bark, have been filled with sand and clay. This, now hardened into stone, constitutes pillar-like casts of the trees, which may often be seen exposed in the cliffs, and which, as these waste away, fall upon the beach. The sandstones enveloping these pillared trunks of the ancient Sigillariæ of the coal, are laminated or bedded, and the laminæ, when exposed, split apart with the weather, so that the trees themselves become split across; this being often aided by the arrangement of the matter within the trunks, in layers more or less corresponding to those without. Thus one of these fossil trees usually falls to the beach in a series of disks, somewhat resembling the grindstones which are extensively manufactured on the coast. The surfaces of these fragments often exhibit remains of plants which have been washed into the hollow trunks and have been embedded there; and in our explorations of the shore, we always carefully scrutinized such specimens, both with the view of observing whether they retained the superficial markings of Sigillariæ, and with reference to the fossils contained in them. It was while examining a pile of these 'fossil grindstones,' that we were surprised by finding on one of them what seemed to be fragments of bone. On careful search other bones appeared, and they had the aspect, not of remains of fishes, of which many species are found fossil in these coal-measures, but rather of limb-bones of a quadruped. The fallen pieces of the tree were carefully taken up, and other bones disengaged, and at length a jaw with teeth made its appearance. We felt quite confident, from the first, that these bones were reptilian; and the whole, being carefully packed and labelled, were taken by Sir Charles to the United States, and submitted to Professor J. Wyman, of Cambridge, who recognized their reptilian character, and prepared descriptive notes of the principal bones, which appeared to have belonged to two species. He also observed among the fragments an object of different character, apparently a shell, which was recognized by Dr. Gould, of Boston, and subsequently by Mr. Deshayes, as probably a land-snail, and has since been named *Pupa vetusta*.

"The specimens were subsequently taken to London and re-examined by Professor Owen, who confirmed Wyman's inferences, added other characters to the description, and named the larger and better preserved species *Dendrerpeton Acadianum*, in allusion to its discovery in the interior of a tree, and to its native country of Acadia, or Nova Scotia.

"In form, *Dendrerpeton Acadianum* was probably lizard-like; with a broad flat head, short stout limbs, and an elongated tail; and having its skin, and more particularly that of the belly, protected by small bony plates closely overlapping each other. It may have attained the length of two feet. The form of the head is not unlike that of Baphetes, but longer in proportion, and much resembles that of the labyrinthodont reptiles of the Trias.

"This ancient inhabitant of the coal-swamps of Nova Scotia, was, in short, as we often find to be the case with the earliest forms of life, the possessor of powers and structures not usually, in the modern world, combined in a single species. It was certainly not a fish, yet its bony scales, and the form of its vertebræ, and of its teeth, might, in the absence of other evidence, cause it to be mistaken for one. We call it a batrachian, yet its dentition, the sculpturing of the bones of its skull, which were certainly no more external plates than the similar bones of a crocodile, its ribs, and the structure of its limbs, remind us of the higher reptiles; and we do not know that it ever possessed gills, or passed through a larval or fish-like condition. Still, in a great many important characters, its structures are undoubtedly batrachian. It stands, in short, in the same position with the Lepidodendra and Sigillariæ, under whose shade it crept, which, though placed by palæo-botanists in alliance with certain modern groups of plants, manifestly differed from these in many of their characters, and occupied a different position in nature. In the Coal period, the distinctions of physical and vital conditions were not well defined; dry land and water, terrestrial and aquatic plants and animals, and lower and higher forms of animal and vegetable life, are consequently not easily separated from each other. This is, no doubt, a state of things characteristic of the earlier stages of the earth's history, yet not necessarily so; for there are some reasons, derived from fossil plants, for believing that in the preceding Devonian period there was less of this, and consequently that there may then have been a higher and more varied animal life than in the Coal period. Even in the modern world also, we still find local cases of this early union of dissimilar conditions. It is in the swamps of Africa, at one time dry, at another inundated, that such intermediate forms as Lepidosiren occur, to baffle the classificatory powers of naturalists; and it is in the stagnant unaerated waters, half swamp, half lake or river, and unfit for ordinary fishes, that the semi-reptilian Amia and Lepidosteus still keep up the characters of their palæozoic predecessors.

"The dentition of Dendrerpeton shows it to have been carnivorous in a high degree. It may have captured fishes and smaller reptiles, either on land or in water, and very probably fed on dead carcases as well.

"All the bones of Dendrerpeton hitherto found, as well as those of the smaller reptilian species hereafter described, have been obtained from the interior of erect Sigillariæ, and all of these in one of the many beds, which, at the Joggins, contain such remains."

Amongst the other reptilian remains found in great trees at South Joggin are a smaller-sized species of Dendrerpeton, *D. Oweni*, the *Hylonomus Lyelli*, *H. aciedentatus*, *H. Wymani*, *H. Dawsoni*, and the *Eosaurus Acadianus*. The *Dendrerpeton Oweni* lived in the same places with its larger congener, but it may have differed somewhat in its habits; its longer and sharper teeth may have been better suited for devouring worms, larvæ, or soft-skinned fishes, while those of the larger *Dendrerpeton Acadianum* were better adapted to deal with the mailed ganoids of the period, or with the smaller reptiles, which were more or less protected with bony or horny scales. In the original reptiliferous tree discovered by Dawson and Lyell at the Joggins in 1861, there were, besides the *Dendrerpeton Acadianum*, some small elongated vertebræ, evidently of a different species. These were first detected by Professor Wyman in his examination of these specimens, and were figured, but not named in the notice in the 'Quarterly rnal of the Geological Society.' In a subsequent visit, Dr. Dawson ained from another erect stump many additional remains of these smaller tiles, and, on careful comparison, was induced to refer them to three cies, all apparently generically allied, and for which he proposed the ne of Hylonomus or "forest-dweller." *Hylonomus Lyelli* was an ani-l of small size, of lacertian form, with large and stout hind limbs, capa-of walking and running on dry land; and though its vertebræ were perfectly ossified externally, yet their articulation was sufficiently firm have enabled the creature to erect itself on its hind limbs or to leap. e ribs, long and much curved, imply a respiration of a higher character n that of modern batrachians, and consequently a more vitalized mus-ar system; if to these structural points we add the somewhat rounded ill, indicating a large brain, we have before us a creature which, how-r puzzling in its affinities when anatomically considered, is clearly not e ranked as low in the scale of creation as modern tailed batrachians, or n as frogs and toads. The bony scales, moreover, with which it was ed below, and the ornate apparatus of horny appendages with which it s clad above, show that this little animal was not a squalid, slimy dweller mud, like Menobranchus and its allies, but rather a beautiful and sprightly ant of the coal-formation thickets, "vying in brilliancy and perhaps in ouring with the insects it pursued and devoured." The remains of as ny as eight or ten individuals obtained from three erect Sigillariæ is indication that these creatures were very abundant. *Hylonomus acie-tatus* was about twice as large as the species last described; its habits l food may have been similar, but its dental apparatus was stronger and re formidable. Of *Hylonomus Wymani* no complete remains have been nd; it was very diminutive, all the fragments met with being almost roscopic in size. Its length could not have exceeded 4 or 5 inches, and form was thin and slender. It might be questioned whether this little ature was not the young of one of the other species, but so far a com-ison does not favour such a view.

'*Hylonomus Wymani* probably fed on insects and larvæ, and searched for these among vegetable débris of the coal-swamps, which would afford to a little creature like this ndant shelter. It occasionally fell a prey to its larger reptilian contemporaries; for ntities of its tiny bones occur in coprolitic masses, probably attributable to Dendrer-n. It is interesting to find reptilian life represented at this early period, not only arge and formidable species, but by diminutive forms, comparable with the smallest rds and newts of the modern world. The fact is parallel with that of the occurrence everal small mammalian species in the mesozoic beds. It will be still more signifi-: in this respect if the species of Hylonomus should be found to be truly lacertian er than batrachian."

The *Hylerpeton Dawsoni* was found by Dr. Dawson in the laminated terial which fills the erect trees of the Joggins, the more distinctly sepa-le surfaces of which are often stained with ferruginous or coaly matter, fine clay, so that the fossils which occur on these surfaces are rendered obscure as readily to escape observation. The specimen on which this cies is established consisted of detached bones of a reptile scattered r a surface so blurred and stained, that they escaped notice until most of m were lost, and only fragments of the skull, a jawbone, and a few er bones, were secured. On these fragments Professor Owen founded genus.

On the whole," says Dr. Dawson, "the Hylerpeton must have been generically dis-t from the other reptiles found with it, and it is probable that it was of more aquatic ts, swimming rather than walking; and feeding principally on fish. More perfect specimens would, however, be required in order to warrant any decided statement on these subjects. It is possible, as suggested by Professor Owen, that the affinities of the animal may be with Archegosaurus rather than with any of the other Coal reptiles; but I confess that my present impression is that it tends rather toward the genus Hylonomus. It may possibly be a link of connection between the Microsauria and the Archegosauria."

Besides the foregoing species, Mr. O. C. Marsh added, in 1861, a new animal to the Joggins reptilian fauna, the *Eosaurus Acadianus*,—a species founded on two large biconcave vertebræ, resembling, in many respects, those of Ichthyosaurus, and of which we have already given a notice in this magazine.

"The vertebræ of Eosaurus have been fully and ably described by Mr. Marsh in Silliman's Journal. Agassiz and Wyman regard their affinities as enaliosaurian. Huxley suggests the possibility, founded on his recent discovery of *Anthracosaurus Russelli*, that there may have been labyrinthodont batrachians in the Coal period with such vertebræ. However this may be, if the vertebræ were caudal, as supposed by Mr. Marsh, since they are about 2½ inches in diameter, they would indicate a gigantic aquatic reptile, furnished with a powerful swimming tail, and, no doubt, with apparatus for the capture and destruction of its prey, comparable with that of Ichthyosaurus."

Dr. Dawson next fully describes and discusses the conditions of life and habits of the invertebrate air-breathers, the *Pupa vetusta*, and the gully-worm or millipede, *Xylobius sigillariæ*. In his concluding remarks he attempts to reconcile many of the anomalies seemingly presented by the organic remains of the coal strata. We havé already trenched too largely on our space to follow the Doctor through this portion of his excellent pamphlet, but there is one passage we may well transcribe:—

"In the coal-measures of Nova Scotia, therefore, while marine conditions are absent, there are ample evidences of fresh-water or brackish-water conditions, and of land-surfaces suitable for the air-breathing animals of the period. Nor do I believe that the coal-measures of Nova Scotia were exceptional in this respect. It is true that in Great Britain evidences of marine life do occur in the coal-measures; but not, so far as I am aware, in circumstances which justify the inference that the coal is of marine origin. Alternations of marine and land remains, and even mixtures of these, are frequent in modern submarine forests. When we find, as at Fort Lawrence in Nova Scotia, a modern forest rooted in upland soil forty feet below high-water mark, and covered with mud containing living Tellinas and Myas, we are not justified in inferring that this forest grew in the sea. We rather infer that subsidence has occurred. In modern salt marshes it is not unusual to find every little runnel or pool full of marine shellfish, while in the higher parts of the marsh land-plants are growing; and in such places the deposit formed must contain a mixture of land-plants and marine animals with salt grasses and herbage —the whole *in situ*."

The above paragraph is important, because these considerations are intended to explain the apparently anomalous associations of coal-plants with marine fossils; and there are, perhaps, no other arguments of weight that can be adduced in favour of the marine origin of coal, except such as the Doctor asserts to be based on misconceptions of the structure and mode of growth of sigillaroid trees, and of the stratigraphical relations of the coal itself. To this he adds a judicious and significant reservation, fully in accordance with the opinions we have ourselves long since expressed, and while he maintains the essentially terrestrial character of ordinary coal and of its plants, he admits that cannel coals and earthy bitumen present evidence of sub-aquatic deposition.

Full as is this notice, we have not taken all the cream off the milk of Dr. Dawson's book. We can assure our readers there is abundant fare still left for its readers.

Fig. 1.

Fig. 2.

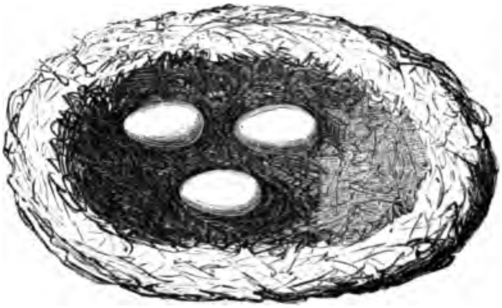


Fig. 3.

FOSSIL BIRDS.—Facsimiles from Kircher and Buttner.

THE GEOLOGIST.

DECEMBER 1863.

PLANETARY ORBITS.

By the Editor.

Every day's experience confirms more and more the opinion that he central heat doctrine has less foundation than formerly it was upposed to possess. Its great supporters have gradually increased he necessary thickness of the solid crust in proportion to the nternal supposed fluid core from forty to eight hundred miles at east: rather a wide difference in itself, but not perhaps so very great n respect to the absolute diameter of the earth, to which such a elationship would be about in proportion to the thickness of a heet of cartridge-paper round a 12-inch globe. We know nothing, owever, so perfectly a non-conductor that so thin would resist the eat of the internal molten mass. Moreover, upon the alleged ncrease of temperature with depth in coal and other mines, much oubt has been thrown by the subsequently ascertained facts that n many instances the higher temperatures have disappeared after he mines had ceased to be worked. The necessity, if the interior vere fluid, for internal tides below the supposed solid crust, also nilitates against the existence of a fluid core, because we can detect o such tides at the surface of our earth; and if they existed, it s difficult to conceive the rigidity and strength of so thin a crust to e equal to restraining them entirely; and if the crust were in the east degree yielding or elastic, we must have evidence of such ides in the heavings of the surface. Besides this, with a shifting xis of rotation, as our earth undoubtedly has, and for other reasons, there must be a motion of the external hardened crust different from that of the internal fluid mass, and this motion must go on, if the present views of mathematicians, astronomers, and internal-heat geologists are right, without any friction. Now, if the earth's crust is the effect of a cooling-down process from a molten condition, there must be a gradual hardening still going on; and with such a gradual hardening, there must be a portion intermediate between the solid crust and the fluid core, which must be in every possible degree of viscosity from next to hard to next to fluid; and if there be any difference of motion between the external crust and the internal core, such an intermediate viscous portion must be a source of much friction, it being absolutely in the very zone where friction would be manifested. There is no manner of doubt whatever that the internal-heat doctrine was invented to account for the supposed former higher temperature of our planet,—a point also not yet proven. Still, we are not adverse to the idea of former *differences* of temperature; but will they be found, when facts and experience have determined more exactly the grander truths, repeatedly variable, or permanently in one direction or the other?

One subject has never, as far as we know, been contemplated by either geologists or astronomers. We are taught at school to believe, and it is generally asserted in society, that the orbits of our earth and the other planets are nearly circular, or at most but slightly elliptical; and these ellipses are supposed to work round periodically, and thus to right themselves. We are taught, too, to believe in the fixity and permanence of the planetary and sidereal systems, and that the great Creator has laid the foundations of the world so sure that they can never be moved. Now, on the contrary, we sincerely believe that all creation, throughout all space, is in as active a state of change as the world we inhabit, upon which no day brings forth its similitude, and no one night is like another. If the sun be a burning body, whatever it consumes must be dissipated as vapour, or solidified as incombustible matter upon its surface. If the sun be dissipating its mass, it is lessening in bulk, and its attraction upon the earth must be lessened. If the sun be adding any residue of combustion to its mass, then the attraction of the sun upon the earth increases. If the attraction diminished, the earth would recede from the sun; if the attraction increased, the earth would be drawn nearer towards it, unless the velocity of the earth in its orbit increased or diminished, so as to make a compensation.

w, as the earth possesses no apparatus for, or power of producing own onward motion, we have no alternative but to consider the ital motion of the earth as due to an initial velocity imparted to originally at some vastly distant period of time. But if we regard earth's motion as originally initial, it becomes at once certain t if the earth in its orbit pass through the ether or matter with ich the circumambient space around us is filled, that there must be no matter how fine, how attenuated that ether may be—*friction;* l friction, however slight, effects retardation. Moreover, the moon ards the earth: as Dr. Tyndall has well expressed it, "she skids earth." Now, if there be a gradual retardation of the earth in orbit, there is a gradual diminishing of the centrifugal velocity ich counteracts the sun's attraction; and if the centrifugal comnsation diminish, the earth must gradually be approaching the sun; the earth's orbit, if originally circular or elliptic, *must* assume a *ral* condition directly there is any alteration of the great counterance of the sun's attraction by centrifugal force, whether that eration be increased or diminished attraction, or increased or ninished velocity of revolution; for with an inward tendency vards the sun the spiral would be a gradually approaching one, and th outward tendency to fly off into space, a gradually extending e. Nor would this spiral orbit produce any effect on the sidereal y or year, for the loss of velocity in the earth would be counterted exactly by the inward contraction of the spiral and the consent shorter distance to run. Again, if the earth's orbital motion due to an initial velocity *imparted* in the remote past, the earth's bit must still be a spiral one, because, if initial and imparted, e original velocity had the nature of *projectile* force, and the tenncy of the original motion must have been in a *direct* or *straight* ne until the earth came *within range* of the sun's attraction; and is attraction diminishing, as a perfect sphere enveloping the central tracting globe or sun, must have been, as far as its influence was erted upon the projected world, a circular influence, from which e earth could not extricate itself, and the resulting figure of the mbination of a straight line and a circle must necessarily be a *iral.*

For very many years I have held this idea of *spiral planetary bits,* and the recent letter of Mr. Hind, the astronomer, on the ssibility of the variation of our earth's distance from the sun, ems to give support to such a conclusion. Certainly a *spiral orbit,* capable of extension or compression, would give play to the earth's distance from the sun, and render intelligible former variations of temperature of our planet. We have before, in this volume, thrown out speculations on possible cosmical occurrences and conditions, and we wish the idea now offered for discussion to be regarded as no more, at present, than a speculation.

ON THE OCCURRENCE OF *WALDHEIMIA (TEREBRATULA) TAMARINDUS*, AND THE DISTRIBUTION OF BRACHIOPODA, IN THE CRETACEOUS ROCKS OF IRELAND.

By Ralph Tate, F.G.S.

E. R. Lankester, Esq., in his paper "On some Cretaceous Brachiopoda,"—see November number of 'Geologist,'—states *T. tamarindus* to be a rare shell; so also in Davidson's 'British Brachiopoda,' Pal. Soc. Publications, the localities for this species given in that monograph are:—Isle of Wight, in Lower Greensand; near Sandgate, in Kentish Rag; and Upper (?) Greensands of Faringdon. I have to add another locality—Colin Glen, near Belfast. This species occurs with us in true Upper Greensand, associated with *Ammonites peramplus*, *Pecten æquicostatus*, *Exogyra columba*, *Vermicularia concava*, etc..

I have generally found it, in masses of 2 or 3 inches in thickness, among the soft chloritic sandstones, and never in a continuous band. I have not met it in any other locality; but individuals may be obtained in abundance in the locality given.

The distribution of this species is thus extended, ranging from the Neocomian to the Upper Greensand.

I take this opportunity of furnishing a list of the Brachiopodous shells of the Cretaceous rocks of the county Antrim.

The species have nearly all been collected in the immediate neighbourhood of Belfast.

Brachiopoda of the Hard Chalk, White Limestone: Upper Chalk. —*Crania Ignabergensis*, Retz, *Rhynchonella plicatilis*, Sow., *Terebratula carnea*, Sow., *T. semiglobosa*, Sow., *T. obesa*, Sow., *T. biplicata*, var. *Dutempleana*, D'Orb., *Terebratulina striata*, Wahl.

Upper Greensand.—*Rhynchonella limbata*, Schlott, *R. latissima*, Sow., *R. compressa*, Lam., *Terebratula biplicata*, Sow., *T. semiglobosa* var. *bulla*, Sow., *Terebratulina striata*, Wahl., *Waldheimia tamarindus*, Sow.

Gault.—*Rhynchonella nuciformis*, Sow., *Terebratula squamosa*, Mant.

FOSSIL BIRDS.

BY THE EDITOR.

(*Continued from page* 424.)

The thick folio book of Athanasius Kircher is an extraordinary one in many respects, and chiefly in respect to the numerous subjects it treats of, and the number of its woodcut illustrations. Rough as these are, they give us a better idea than mere descriptions of the objects he speaks about. Like other of these old authors, he copies a great deal from his predecessors and contemporaries; indeed one gets wearied of this eternal copying by these, for the most part, old doctor-naturalists, and of the endless cross-references from one to another. Still, for our purpose, which is to give all the literature on the subject, we must submit some few more extracts from old books.

The title of Kircher's book is 'Mundi Subterranei,'* and the first reference we meet with is, in Tom. ii. lib. viii. de Lapidibus, sect. 1, cap. ix. p. 34, fig. "avium in lapidibus expressio,"—of birds expressed on stone. (See Vol. VII. Pl. II. Fig. 6.)

We next come to numerous figures of other "flying creatures" at p. 35, etc. Tab. I. is headed, "FIGURÆ VOLUCRUM, quas Natura in lapidibus depinxit, ex variis Museis decerptæ et aliunde transmissæ." "Figures of winged creatures, painted by nature on stones, taken from various museums, and otherwise transmitted."

Then follows the descriptive translation below:—

"The first figure represents a head of a Stork, together with some, but I do not know what, quadruped. At the top is something like a human face. Extracted from Aldobrandino"† (see Pl. XXIII. Fig. 1). "2. Shows various forms and parts of animals, winged creatures as well as quadrupeds, although very imperfect, the cause of which we give in the physical examinations" (see Pl. XXIII. Fig. 2). "3. Represents the figures of two birds expressed by nature on marble in the church of St. George's, at Venice, referred to by Ambrosinus" (see Vol. VII. Pl. II. Figs. 3, 4). "4. Shows the head of an Owl, surrounded by rudiments of other birds" (see Pl. XXIV. Fig. 2). "5. Represents the figure of a Wagtail, or as others prefer, of a Peacock" (Pl. XXIV. Fig. 3). "6. Shows the figure of a monstrous bird" (Vol. VII. Pl. II. Fig. 4). "7. The figure of a Merle" (Vol. VII. Pl. II. Fig. 5).

"Prima Figura notat *Ciconiæ caput*, et annexum ei nescio quid animalis

* "Athanasii Kircheri e Soc. Jesu Mundi Subterranei Tomus IIus, in V. Libros digestus, quibus Mundi subterranei fructus exponuntur, et quidquid tandem rarum, insolitum et portentosum in fœcundo Naturæ utero continetur, ante oculos ponitur curiosi Lectoris.

"'Os νάεις κατὰ πάντα μέρει κόσμοιο γενάρχα
'Os δαπανᾶς μεν ἅπαντα, καὶ αὔξεις ἔμπαλιν αὐτοὺς.

"Omnes qui partes habitas, mundique Genarcha,
Absumis qui cuncta eadem, qui rursus adauges.

"Amstelodami, Ex Officina Janssonio-Waesbergiana, anno 1678."—ORPHEUS.

† The inscription under the fig. 1 (*Ciconiæ et Noctuæ figuræ*) does not correspond with this explanation.

quadrupedis. In summitate *humanæ faciei* quid simile: Ex Aldobrandino extractum. 2. Monstrat varias rerum formas partesque animalium, tam volucrium quam quadrupedum, quamvis valde imperfectas, quarum rationem dedimus in disquisitione physica. 3. Duarum avium imagines monstrat, quas in Ecclesia S. Georgii Venetiis in marmore a natura expressas refert Ambrosinus. 4. Noctuæ caput demonstrat, circumdatum aliis avium rudimentis. 5. Motacillæ, sive, ut alii volunt, Pavonis figuram exprimit. 6. Monstrificæ volucris figuram docet. 7. Merulæ figuram exprimit."

It is necessary to add in this place the inscriptions inserted in Kircher's plate under the figures, and for convenience' sake we give the references to his own instead of our plate.

Fig. 1. Ciconiæ et Noctuæ figuræ. Fig. 2. Confusæ rerum variarum formæ. Fig. 3. Venetiis in templo S. Georgii. Fig. 4. Caput Noctuæ. Fig. 5. Figura Motacillæ. Fig. 6. Animalis jubati.

In Ritter we find a cross-reference to Seyfrid's 'Medulla Mirabilium Naturæ,' p. 437; but on turning to the work,* we find in the subjects treated there nothing relating to birds. The passage at p. 437 runs, roughly translated, thus:—

"In America, about Chili, there is on a mountain plenty of precious stones. In a cavern, the image of the Most Holy Virgin, with her baby in her arms; admired by all spectators."

Turning over to p. 438, we read that at "half a mile from the convent Michelfield is a quarry, where stones forming round plates, and bowls, are so perfectly manufactured by nature, that the people never want any china or earthen vessels for domestic purposes."

In glancing over the pages, however, we come upon a passage at page 458, of which the following is a translation:—"Even in France, at Limans, a village or Provence about a league distant from Forcalquier, a city of good note, there hath been sometime found, in a certain mine of a kind of reddish soft stone, a great number of these *Gamahes*, or painted figures, of birds, mice, trees, serpents, and letters, so exactly shaped that little children could tell what they were.—*Gaffarellus*."

The work of Gaffarell, from which this extract is made by Seyfrid, bears the title of—"Cvriositez inovyes svr la Scvlptvre Talismaniqve des Persans. Horoscope des Patriarches, et Lectvre des Estoilles." and was published in 1637.† There was an English translation by Edmund Chilmead, Master of Arts, and Chaplaine of Christ Church, Oxon, printed at London in 1650. The passage in which, at p. 104, is given above as the translation.

* "Medulla Mirabilium Naturæ. Das ist: Auserlesene, unter den Wundern der Natur, aller verwünderlichste Wunder, von Erschaffung der Natur, Himmlischen Firmaments, Sternen, Planeten, und Cometen; als auch dieser sichtbaren Welt, und des Meers. Dessgleichen, in Brunnen, Flüssen, Seen, und dem Meer; Auf, An, und in Gebürgen, Erden, und Insulen; Wie auch, etzlichen Thieren, Bäumen, Früchten und Gewächsen. In Europa, Asia, Africa und America. Aus hiernächst benandten Autoren zusammen getragen und beschrieben; sammt beygefügten Kupffern. Durch Johann Heinrich SEYFRID, Marco Brettano Francum; Hoch-Fürstl. Durchl. zu Pfaltz-Sultzbach Hof-Bedienten. Sultzbach. In Verlegung Johann Hofmanns, Kunst- und Buch-Händlers in Nürnberg. Druckts Abraham Lichtenthaler, 1679."

† The extract is from page 78 of the French, and page 104 of the English edition.

Johannes Christianus Kundmann, a doctor of Wratislaw, in his 'Promptuarium Rerum Naturalium et Artificialium Vratislaviense,' published in 1726, says (p. 67) that a petrified egg was discovered at Wizin, in Bohemia, and that "a petrified foot of a big *Paviran*, with all its five nails, was discovered in Silesia,"—adding, "this is a very curious specimen, the like of which is not to be found in any museum, and the more curious as it shows even the blood converted into stone."

What a "paviran" is, we confess to be ignorant. *Pavara* is an Italian name for the domestic duck; but the "five nails," which the fossil referred to by our author possesses, renders more than doubtful any association with the foot of the *Anas anser*.

The passage in the original German is:—

"Ein zu Stein gewordenes Ey, welches zu Wizin in Böhmen gefunden; ein zu Stein gewordener Fuss mit allen 5 nägeln von einem grossen Paviran, welcher in Schlesien gefunden worden (dieses ist ein curiöses Stück, welches man in keinem Cabinet finden wird, weil auch so gahr man das Blut oben noch siehet, das zu Steine worden)."—P. 67.

Further on in this work, we find in his Catalogue of "Marmora, Stalactitæ, Lapides speculares, calcarii, tophacei, arenæ," etc., the record of "an egg entirely incrusted with tufa:"—

"110. Topho Ovum totum ibidem incrustatum (s. 513). Tophum hunc descr. *Gothfr. Berger*, 'de Thermis Carolinis,' p. 14–20. Alios vero descr. in *Georg. Agricola* de Nat. Fossil. lib. vii. cap. xii. p. 640. *Ans. Boetius* in Hist. Gem. et Lapid. lib. ii. cap. ccxix. p. 402. *Joh. de Laet* de Gem. et Lapid. lib. ii. cap. xii. p. 132. Prc. *Ul. Aldrovandus* in Mus. Metallic. lib. iv. p. 703. *Ol. Wormius* in Museo, lib. i. cap. vi. p. 51. *Boh. Balbinus*. Miscell. Hist. Reg. Bohem. lib. i. cap. xxiv. p. 63; it. *Rob. Ploot*, Nat. Hist. of Oxfordshire, p. 34, et ex eo *Joh. Jac. Scheuchzerus*, Hydrographiæ Helvetiæ (quæ est Hist. Natur. Helveticæ, part ii. p. 320), cons. *Carol. Nic. Langii*, Hist. Lap. fig. Helv. part ii. lib. iii. cap. ii. p. 55."

Still further on, in his Catalogue of "parts of other petrified animals," we have the following entry at page 254:—

"17. Oscicula petrefacta avicularum alba accuratissima ex monte Hassiæ, vulgo 'dem Vogels-Berge,' eruta (s. 314).

"18. Oscicula talia petrefacta lævia Maslensis coloris nigricantis s. 322)."

Vid. *Leonh. Dav. Hermann*, Maslographia, part ii. cap. ix. page 224. Varias Opiniones collegit *Dav. Signi. Büttnerus* in Rud. Diluvian. page 304.

There are several reprints of Zannichelli's catalogue of the fossils in his museum. The one usually quoted from is the "ENUMERATIO RERUM NATURALIUM QUÆ IN MUSÆO ZANNICHELLIANO ASSERVANTUR," published at Venice in 1736, in which he notes "a hen's egg discovered in a very hard stone" by the following entry:—

"Musæi Zannichelliani abacus alter, in quo fossilia figurata continentur."
206. Ovum gallinaceum in saxo durissimo inventum ex Agro Romano."

We find the record, however, ten years earlier, in his "EX NATURÆ

GAZOPHYLACIO PENES JOANNEM HIERONYMUM ZANNICHELLI VENETIIS. Index Primus quo Fossilia figura recensentur.—Venetiis, 1726."

"206. Ovum gallinaceum in saxo durissimo inventum ex Agro Romano."

. The next work we meet with is the 'Magnalia Dei' by Bruckmann* (1730). Two figures, which he engraves, are the same as Hermann's in our Plate XXII. Fig. 3, and Wolfart's in our Plate XXIII. Fig. 3. A third figure of Bruckmann seems to be an engraved seal. His reference runs thus:—

"DIETZ, eine Graffschafft, hat Eisen-Gruben und schönen Marmor, und schreibt Petrus Wolfart in seinem Vale Hanoviæ et Salve Cassellæ dicto, etc., von diesem Marmor zu Dietz, p. 24, also: *Minime vero Marmoribus,*" etc. etc.—Bruckmann, 'Magnalia Dei in Locis Subterraneis,' ii. p. 107. [DIETZ, a county, has iron-mines and beautiful marble; Petrus Wolfart, in his 'Vale Hanoviæ et Salve Cassellæ,' etc., in speaking about the marble of Dietz, says, p. 24: *Minime vero Marmoribus,*" etc. etc.]

Retzius, 'Historia Naturalis Dendritæ Lapidumque Cognatorum,' 1734,† is the next work we quote from. He says:—

"To conclude, we present here a list of the dendritic and other similar stones conserved in our stone-collection of Lund, and which can throw some additional light on our work; the following are the most interesting among them:—20 (p. 109). A flint stone or a common pyrites, representing a figure of a small *bird*, perhaps the Geranites of Pliny, Croppensis, plate iii. fig. 5."

(See our Plate XXIV. Fig. 7.)

The original passage runs:—

"§ XIII. Coronidis loco subnectam jam indicem eorum dendritatum cognatorumque lapidum in lithophylacio nostro Lundensi asservatorum, qui huic nostræ lucubrationi aliquam lucem fœnerare posse videntur; sunt autem eorundem specimina quæ sequuntur, præcipua.

"20 (p. 109). Silex seu pyromachus vulgaris aviculæ figura insignitus, forte Geranites Plinii, Croppensis, tab. iii. fig. 5."

* "Magnalia Dei in Locis Subterraneis, oder Unterirdischer Schatz-Kammer aller Königreiche und Länder, IIter Theil, in ausführlicher Beschreibung aller, mehr als MDC Bergwercke durch alle vier Welt-Theile, welche von Entdeckung derselben bis auf gegenwärtige Zeit gebauet worden, und noch gebauet werden; in was Stande sie jemals gewesen, und wie sie itzo beschaffen; was für Ertze, Steine und Berg-Arten aus solchen jemals gewonnen, und noch zu Tage ausgefördert werden; nebst Anmerckung aller derjenigen Länder und Oerter, wo Edelgesteine zu finden. In Geographischer Ordnung vielen Kupffer-Figuren und Alphabetischen Register, zu besichtigen dargestellt von Francisco Ernesto BRUCKMANN, Med. Doct. Acad. Cæsar. Nat. Curios. et Soc. Reg. Pruss. Scient. Colleg. et Pract. Wolffenbutt. Wolffenbüttel. MDCCXXX."

† "Historia Naturalis Dendritæ Lapidumque Cognatorum quam amplissimo Philosophorum ordine in Alma Carolina veniam indulgente, Præside V. CL. DN. Doct. Kilian Stobæo, Archiatro Regio Histor. P. P. et O. Facult. Philosoph. h. a. Decano spectabili, nec non Soc. Reg. Lit. et Scient. Upsali Sodali meritissimo, dignissimo, Præceptore, ut Fidelissimo. Ita omni Reverentia Cultuque ad cineres suspiciendo pro Laurea Philosophica Naturæ Curiosorum Benevolæ Disquisitioni Modeste submittit Nicolaus REIZIUS, Med. Stud. Loco horisq. solitis ad d. 27 Maji anni M.DCC.XXXIV. Londini Gothorum, Typis Ludovici Decreaux."

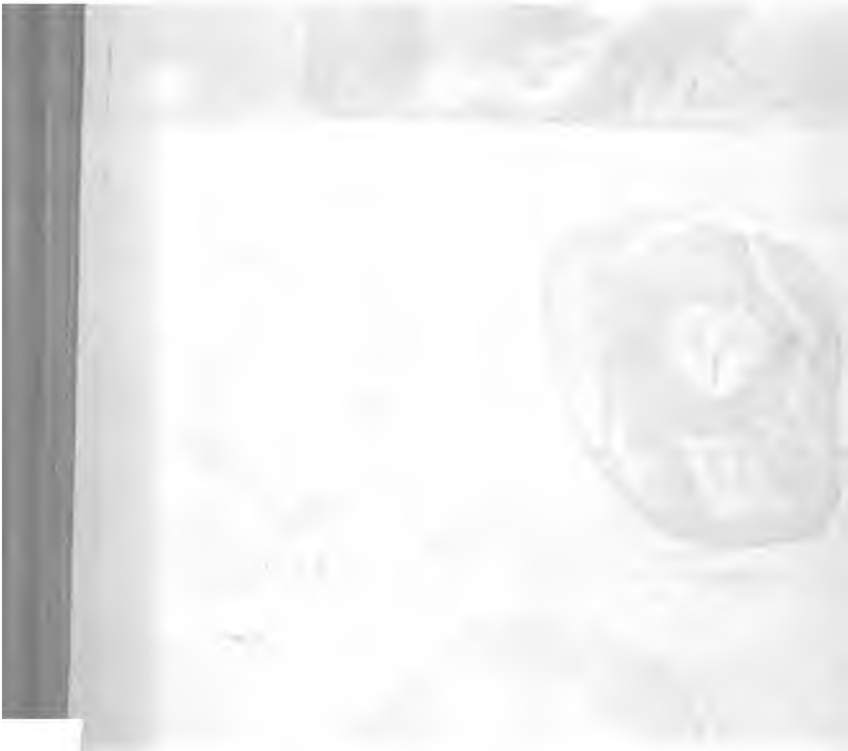
Fig. 1.

Fig. 2.

Fig. 4.

Fig. 3.

FOSSIL BIRDS.—Facsimiles from Wolfart, Kircher, Retzius, and Ritter.



en. Jac. Sivers, in his 'Curiosa Mendorpiensia,' Lubeck, 1734,)7,* catalogues the head of a goose in hard flint,—no doubt, as he esses it, "an elegant lusus naturæ." The entry is—

r. Lapis, caput anserinum ab utroque latere accurate repræsentans, e ısimo silice elegans naturæ lusus."

nother book of this class and similar date is Lesser's 'Lithotheo-ɜ,'† published in 1735. What we learn from him is that—

The late Mr. Cuno, the distinguished musician and organist at our ·opolitan church, discovered once, in the neighbourhood of Heringen, ıt stone, and in breaking it he found on both sides the head, together the neck, of a *Calcutta cock*. It is of a reddish-yellow colour, the ɜan very distinctly be perceived, as well as the comb bending over the :. I conserve this stone in my museum, and can show it to any one." . iii.)

ee Vol. VII. Plate II. Figs. 7, 8, *nobis*.)

he original is :—

Der seelige vortreffliche Virtuose und Organiste an hiesiger Haupt· :he, Herr Cuno, hat ehemahls bei Heringen einen Feuerstein gefunden, zerstuffet, in welchem auf beiden Seiten der Kopf mit dem Halse einem Calcutischen Hahn zu sehen. Er ist gelb-röthlich, das Auge nguirt sich darauf ganz deutlich, und die über dem Schnabel hängende e gleichfalls. Welchen Stein ich in meinem Cabinet jedem zeigen ı."

[e also refers, at page 406, to Bruckmann :—

Dr. Bruckmann recollects a marble on which the head of an *owl* is re-ented."‡

ı 1736, Albert Ritter published a book § on dendritic resemblances ch he illustrated with figures of the specimens. In his list of osities of this class he enters, page 20 :—

Brit. Mus. 436. a. 36. The title-page reads :—" Q. F. F. Q. S. Henrici Jacobi ᴇs Lubecensis, Philosophiæ Magistri et Regiæ Borussicæ Scientiarum Societatis ·gæ, Curiosorum Niendorpiensium, Specimen sextum et ultimum, sistens Conchi-n aliorumque Lapidum miscellaneorum descriptionem, cum viro excellentissimo atque rientissimo Domino Joachimo Theodoro Hornhard D. Serenissimi Ducis Mecklen-ici Archiatro et Consiliario Aulico communicatum. Lubecæ apud Petrum Boeck-num, 1734."

"Friedrich Christian Lessers, der Kirchen am Frauenberge in der Kayserl. freyen hs-Stadt Nordhausen Pastoris, und des Waysen-Hauses daselbst Administratoris, ɪothеologie, das ist : Natürliche Historie und geistliche Betrachtung derer Steine, abgefasst, dass daraus die Almacht, Weissheit, Güte und Gerechtigkeit des grossen ıpffers gezeuget wird, anbey viel Sprüche der Heiligen Schrift erkläret, und die scheu allesamt zur Bewunderung, Lobe und Dienste des grossen Gottes ermuntert en. Zum Druck befördert und mit einer Vorrede begleitet von Johann Alberto icio, Doct. und Prof. Publ. des Gymnasii zu Hamburg. Hamburg, bey Christian ıelm Brandt. 1735."

"§ 295. Herr Dr. Bruckmann gedencket eines Marmors, auf welchem ein Eulen-f sich praesentirt."

The title runs :—" Alberti Ritter Gymnasii Ilfeldensis Regii Con-rectoris Commen-II. de Zoolitho-Dendroidis in Genere et in Specie de Schvvartzburgico-sonders-nis curiosissimis ac formosissimis, una cum Supplemento Rerum Naturalium et osarum hujus Regionis in Lucubratiuncula II. de Alabastris Schvvartzburgicis dam a me Delineatarum jam denuo Recognitarum et Auctarum, Typis Exscripta Figuris Æneis. Sondershusæ, 1736."

"*Paro* lapidi a natura inscriptus; Plinius, part i. p. 13.
"*Gallus* in marmore; Kircher, Mund. Subter. tom. ii. p 39.
"*Gallina* in rene lapidis fissilis Ilmenauiensis; Mylius, loc. cit. part i. p. 47; item part ii. p. 73. fig. n. 1.
"*Aves* in fissili lapide Bottendorffiensi; Mylius, loc. cit. part i. p. 13. Aves et flores varii generis in marmore Eichstadiensi; vide Seyfried, 'Medullam Mirabilium Naturæ,' p. 437.
"*Aviculæ* figuræ silex, sive pyromachus vulgaris Croppensis insignitus forsan Geranites Plinii est; Excellent. Stobæus in Hist. Natur. de Dendritis, p. 34, n. 20, t. ii. fig. 5.
"*Caput ululæ* in marmore Dietzensi; celeberr. D. Bruckm. Magn. Dei, part ii. p. 107, t. 27, fig. 2.
"*Caput gallopavi* cum parte colli in pyrita; venerand. Lesser, in Lithotheol. p. 406, fig. n. 1. et 2."

Bruckmann (1749), in his 'Epistolarum Itinerarium,'* copies Ritter's (see *ante*, page 449) plates and descriptions of the dendritic stones, the bird-figures on which are given in our Pl. XXIII. and Pl. IV. in Vol. VII. The descriptions are printed above.

Tab. XXII. p. 343. "Porro ex ejusdem Comment. II. de Zoolithis-Dendroidis offero: Fig. 1. Lapidem quadratum, coloris lucido-cæsii, exhibentem arbusculas et fruticeta coloris nigerrimi, intermixtis nonnullis ramulis coloris punicei."

At another part of his work he describes two dendritic stones, of which he gives elaborate copper-plate engravings. One is figured in our Pl. XXIII. Fig. 3, and the other part of an extensive landscape, in which there is a pig as big as a house or a house as small as a pig, whichever the reader or spectator like, and flying away from a row of bushes, what Ritter describes, as "a *bird*, with a long tail, the head adorned with long and erected feathers, the wings displayed, flying through the *air*, expressed distinctly by nature;" but which looks as much like an insect as a bird, and really, to our eyes, has as little resemblance to one as the other. We give a facsimile (Pl. XXIV. Fig. 1) of this object, as evidence of the imaginative faculties of a naturalist a hundred and fifty years ago; and add also the original passage describing the specimens.

"Numer. III. Lapis habet figuram geometricam nempe trapezoidalem, longus est ipsum pedem, latus tres pollices, crassus semipollicem; segmentum hoc est lapidis, qui crassitudine ipsam excedebat palmam; ambo latera sunt optime lævigata et polita, etiam subtili et perlucente vernice obducta, hinc multo elegantius et vividius sistuntur omnia; naturali magnitudine hunc, et jam descriptos lapides æri cælari curavimus, fruticeta, arbusculæ, imagines reliquæ elegantissime et plenissime sunt expressæ, nigerrimi coloris; sed quod nomen huic lapidi inponamus, ipsi hæsitamus, forsan cum B. Baiero illum nominare possimus *archipelagitem*, cujus quidem descriptioni non absimilis,† concedet tamen benevolus lector et spectator

* "Francisci Ernesti Bruckmanni Phil. et Med. Doct. Acad. Cæsar. Leopoldino-Carolinæ Nat. Cur. ut. et Societ. Regio-Prussicæ Scientiarum Membri, juxta ac Assessoris Colleg. Medici Illustr. Brunsvic. et Poliatri Wolffenbüttelensis. Centuria Secunda Epistolarum Itinerarum accedit Museum Closterianum. Wolffenbüttelæ, MDCCXLIX."
† In Sciagraphia Musei sui et Supplementis Oryctogr. Noricæ, p. 49.

›sus, nobis imaginari, lapidem repræsentare quoddam stagnum, mar-s cujus circumcirca fructicetis sunt obsessæ, in hoc adparere insulas ›res, minores, minimas, easque fruticetis mollibus obductas, et quod :imis admiratione dignum, simul in illis videri ædem parvam cum fuma-non procul hinc animal quoddam quadrupes, cui spectatores nomen indiderunt, quipp cujus non dissimilis, adhuc *avem* cauda longiore, in te pennis longioribus et erectis ornatam, expansis alis per auras volan-. exactissime a natura ludente expressa quæque; et quia notatæ :æ ipsum penetrant lapidem, in altero latere similiter indicata adparent, solummodo variatione, ut dicta animalcula desiderentur, etiam hic vel novus quasi efflorescat ramulus arboreus, imprimis, si lapis fissuras as acceperit. Quando nunc secundum proverbium: *Deus et natura ! faciunt frustra*, æquum erit, hæc miracula adspicientes Deum mira-n, inque operibus suis inperscrutabilem debite mirari, atque decentibus ibus extollere, namque testante Psalmista: *Opera Jehovæ magna, expo- omnibus qui delectantur illis, gloriosum et decorum opus ejus.*"

he following is Ritter's account of fig. ii. (see Pl. XXIII. Fig. 3, •), referred to in the above quotation:—

Fig. II. An oblong squared stone, polished, exhibiting very ular pictures; a whole region, hills covered with very small bs, mountains slightly rising, broken stones and rocks, grass, even reeds, a rustic cottage ornamented at its ridge with green ;hs of a tree, a strange *bird*, not unlike the ostrich, black clouds ' disposed for throwing flashes," etc.

he original we give below:—

Fig. II. Lapidem quadratum oblongum, politum, offerentem picturas ə singulares, integram regionem, colles subtilissimis fruticetis ornatos, ;es parvos acclives, rupes ac saxa prærupta, cum gramine nec non dine, casam rusticam fronde quasi viridi in culmine ornatam, *avem* ;rinam, struthioni non absimilem, nubem nigriorem, quasi fulgora tentem," etc.

/e quote now from ‘L'Histoire Naturelle, éclaircie dans une de ses ies principales, l'ORYCTOLOGIE, qui traite des Terres, des Pierres, Métaux, des Minéraux et des autres Fossiles, enrichi des Figures inées d'après Nature.' By M. *** (Ant. Jos. Dezallier d'Ar-;ville) des Sociétés Royales des Sciences de Londres et de Mont-;r.—Paris, 1755.

nder the heading BIRDS, M. Argentville says:—"It is quite ıin that birds, owing to the faculty they possess of flying, more easily escape immersion than any other animal; and this ıe reason of the scarcity of petrified birds, and why we only find r débris, such as their feathers, nests, and eggs. The feathers the tail of a bird found on a stone at Oeninghen (Scheuchzer), ;ak of a petrified bird, on a black stone, in the same country ıs. Zannichelli); a petrified cuckoo, commonly called *Pesce capone;* ı, birds' nests enclosed in stone; feathers and petrified nails, ex-ted by the limestones of the parish of Karabglony, in the province Vestrogothland, in Sweden (Bruckmann). *Ornitholitus nidorum ıriæ:* a stone containing a nest of a petrified Linnet, incrusted . salt of tartar, from Artern. *Tubulites* full of small worms, found in the island of Gothland. *Gallina cum ipsis ovis incubans*, a hen hatching her eggs, found petrified in a salt-pit of Transylvania (*De Thermis* And. Baccii)."

The following is the original in the French:—

"OISEAUX.—Il est certain que les oiseaux, par la facilité qu'ils ont de voler, se sauvent plus facilement de l'immersion que les autres animaux; c'est ce qui fait la rareté des oiseaux pétrifiés, et qu'on n'en trouve que les débris, tels que des plumes, des nids, des œufs. La plume et la queue d'un oiseau, trouvées sur une pierre d'Œninghen (Scheuchzer).

"Un bec d'oiseau pétrifié, sur une pierre noire du même pays (Mus. Zanichelli).

"Un coucou pétrifié, appelé communément *Pesce capone*.

"Des œufs, des nids d'oiseaux, enclavés dans la pierre.

"Des plumes et des ongles pétrifiés, que montrent des pierres calcaires, de la paroisse de Karabglony, province de Westrogothland, en Suède (Bruckmannus).

"*Ornitholithus nidorum Linariæ*, pierre contenant un nid de Linote pétrifié, incrusté de sel de tartre, venant d'Artern.

"*Tubulites*, pleins des vermisseaux, trouvés dans l'Isle de Gotland.

"*Gallina cum ipsis ovis incubans*, une poule couvant ses œufs, trouvée pétrifiée dans une saline de Transilvanie (*De Thermis*, And. Baccii)."

As D'Argentville refers to insect-remains in the 'Stone of Oeningen,' there is no doubt of its being the well-known limestone of that place. At page 334, after the insects from the "stones" of Frankenberg and of Wirtzburg, he adds:—

"*Ornithoglossum*, glossopetrum imitating the tongue of a pie, from Malta. (Lindius.)

"*Gracirrhynchus*, glossopetrum imitating the beak of a raven. (Lachmundus).

"A petrified nest, with its chickens, discovered near the city of Lubeck, according to Albertus Magnus, as reported by Lachmundus."

We add the original:—

"*Ornithoglossum*, glossopètre imitant la langue d'une pie, venant de Malte. (Lindius).

"*Gracirrhynchus*, glossopètre imitant le bec d'un corbeau. (Lachmundus).

"Un nid pétrifié, avec ses poulets, trouvé près de la ville de Lubec, selon Albert le Grand, au rapport de Lachmundus."

Our next author is JOHAN GESNER, Med. D., Phys. et Math. Prof. Ord. Academiæ Imperialis Naturæ Curiosorum, et Socc. Regiar. Scientiar. Berolinensis, Sueciæ, Upsal., Gœtting., Physico-Botanicæ Florentinæ, ut et Physico-medico Basiliensis membr., in whose 'Tractatus Physicus de Petrificatis, in duas partes distinctus, quarum prior agit de Petrificatorum differentiis et eorum varia origine; altera vero de Petrificatorum variis originibus, præcipuarumque Telluris mutationum testibus (Lugduni Batavorum, 1758),'* are the following passages:—

* We have since found these passages in an earlier work of Gesner's:—"ΣΥΝ ΘΕΩ. Dissertatio Physica de Petrefactorum differentiis et varia origine, quam, auxiliante Deo,

"CAP. XX. p. 66.—*Zoolithus avis*, or Ornitholitus, is a petrified bird, which is very seldom to be met with amongst the Petrificata.

"1. *Ornitholitus avis integræ.*—Ornitholite of a whole bird, which, according to Linnæus and Wallerius, is conserved in some museum, has never met my eye; and these stones must at all events be very scarce, as birds, owing to the use of their wings, very easily escape the dangers of waves and immersion.

"2. *Ornitholitus plumarum.*—Ornitholite of feather. Scheuchzer, in his 'Vindiciæ Piscium,' describes a specimen of such a fossil bird's feather in stone discovered at Oeningen.

"3. *Ornitholitus nidorum.*—Petrified nests. They are found sometimes in the subterranean caverns full of stalactites, and in tufas; but they may be rather classed amongst the incrustata, or incrustations, than amongst the lapidifacta, or petrifactions. Such a nest was discovered in a cave by Baumann; five others are described by Bruckmann. These incrusted nests are sometimes formed from stalactite, or earth deposited from saline water in layers within the apartment.

"Such a nest of a linnet, together with its eggs, incrusted with salt of tartar, discovered at Artern, is quoted by the said Bruckmann in his 'Museum,' and a similar one is to be seen in the museum of Ritter, tab. 44, f. 5.

"Such true incrustations, as well as others of this class, are not unfrequently encountered in salt-pits. A very curious specimen is quoted by Bacci And. in his work 'De Thermis,' lib. v. c. 4, p. 157. In some place of Transylvania, he says, there was in a salt-pit a hen discovered hatching her eggs, and which, owing to the salt with which she was covered, was preserved incorrupted, and is still to be seen."

The original Latin of the text we give below:—

"CAPUT XX. (p. 66.)

"*Zoolithus Avis* seu *Ornitholitus* est Petrificatum Avis. Hoc inter Petrificata maxime infrequens esse solet.

"1. *Ornitholithus avis integræ* quoad nomen exstat apud cl. Linnæum et Wallerium in museo quodam conservetur, mihi non constat. Sed non possunt non rarissimi esse hi lapides, quum Aves alarum ministerio undis et submersionis periculis se facile subducant.

"2. *Ornitholithus Plumarum.* Lapidem fissilem Œningensem, qui Avis Pennam referat, describit et depingit cel. Scheuchzerus in Vindiciis Piscium, tab. ii.

"3. *Ornitholithus Nidorum*, quandoque in Cryptis subterraneis Stalactita prægnantibus, et inter Tophos occurrit, sed inter incrustata potius quam lapidifacta referri meretur. Hujus generis nidum possideo in antro Baumannio inventum; alios quinque recenset clar. BRUCKMANNUS.* Formantur ejusmodi nidi incrustati nonnunquam et stalactita vel

Præside Johanne GESNERO, Med. D. Phys. et Math. Prof. Ord. Academiæ Imperialis Naturæ Curiosorum, et Soco. Regiar. Berolinensis itemque Succicæ Upsaliensis, ut et Physico-Botanicæ Florentino Membro, pro consequendo Examine Philosophico, defendent David à Moos, Casparus Ammianus, Felix Hofmeisterus, Rodolphus Dænikerus, Henricus Kilchspergerus, Joh. Luc. Salomon Wolfius. At d. 21 Mart. H. L. Q. S. Tiguri, Ex Officina Gessneriana. An. MDCCLII."

* Epist. Itiner. Centur. ii. p. 25, tab. 7, 8. Wolfenb. 1749, 4.

terra, quam deponit aqua Salina in domo gradatoria (*Gradierhaus*). Talem nidum Linariæ totum una cum ovis, tartaro salino incrustatum de *Artern* allatum, recenset ex suo museo laudatus Bruckmannus,* et similem ex Museo Ritteriano sistit tab. xliv. f. 5. *Sale vero incrustata* non raro hæc et alia hujus generis in salifodinis reperiuntur. Memorabile exemplum prostat apud Baccium† de Thermis, l. v. c. 4, p. 15. Quodam loco (sic scribit) in Transylvaniæ Salifodinis Gallina cum ipsis ovis incubans reperta est, quæ eo obducta sale servata est, ac incorrupta etiam nunc ostenditur."

In the 'Dictionnaire Universel des Fossiles Propres et des Fossiles Accidentales,' by M. E. Bertrand, Premier Pasteur de l'Église Françoise de Berne, Membre des Acad. de Berlin, etc., published at La Haye in 1763, ornitholites are thus described, at page 86:—"Parts of petrified birds. Ornitholite, *Avium petrificata.* In German, 'versteinerte Vögel,' or 'Vögel-knochen.' The ornitholites are very scarce. I am not sure if there has been a single entire petrified bird ever seen, however Linnæus and Wallerius speak of them. The parts of these birds, or the remains belonging to them, which are more commonly met with, are the horny parts, the beaks, bones, nails, eggs, and nests; but at all events there is always a fear that persons may be deceived by resemblances in which the fancy as well as the desire for some curiosity plays its part. See F. Gessner, de Petrificatis, cap. xx. p. 66."

The original runs:—

"Ornitholites, ou parties des oiseaux pétrifiées. Ornitholithe, Avium petrificata. En allemand: versteinerte Vögel, oder Vögel-knochen. Les ornitholites sont fort rares. Je ne sçai si on a jamais vu d'oiseau entier pétrifié, quoique Linnæus et Wallerius en parlent. Les parties de ces oiseaux, ou qui leur appartiennent, les cornes, le bec, les os, les ongles, les œufs, les nids, peuvent être plus communs. Encore est-il fort à craindre qu'on n'ait été trompé par une ressemblance, à laquelle l'imagination et le désir des choses rares aura prêté quelque chose. Voyez G. Gesner, de Petrificatis, cap. xx. p. 66. Lugd. Batav."

The next notices that we find of bird-remains are in Davilla's 'Catalogue,' a rather remarkable book. Under the head of Ornitholites, in the 'Catalogue Systématique et Raisonné des Curiosités de la Nature et de l'Art, qui composent le Cabinet de M. Davilla (Paris, 1767, vol. iii. p. 225), we read:—

"*Ornitholites.*—Ces pétrifactions sont les plus rares de toutes, à moins qu'on ne veuille y ranger les Nids d'Oiseaux, les plumes et autres parties de ces animaux, que l'on trouve incrustées par les eaux de certaines fontaines; mais ces incrustations ne sont point des Pétrifications proprement dites et appartiennent à une autre classe.

"301. Un bec d'oiseau, imprimé en relief dans un schiste, de Reutlingue. Ce bec est un peu entr'ouvert, strié en-dessus, et porte quatorze lignes de long sur cinq dans sa plus grande largeur. Plus; Os fossile, de Canstadt, orné presque en entier de très-jolies Dendrites, et que paroît être l'os de la cuisse d'une Poule."

* Epist. Itiner. Centur. ii. p. 587.

† De Thermis Andreæ Baccii, lib. vii., ed. noviss. Patav., 1711, f.

In another chapter Davilla records the following fossils from ınstadt, therefore probably from the same beds as his Ornitholite:— olar teeth of Rhinoceros, "Une canine, blanche, à petites herborisaons bleuâtres, adhérente à une portion de mâchoire pareillement rborisée;" another tooth, "Arborisée . . . son intérieur est calciné adhère fortement à la langue;" six other teeth, "Sçavoir, deux borisées, de Canstadt, l'une de Rhinoceros,* l'autre inconnue,† ux simplement fossiles, dont une de Cheval dans son alvéole. Plus, ıe portion de mâchoire aussi fossile, trouvée à Canstadt," and teen other bones unnamed. These memoranda would lead one to fer the Canstadt Ornitholite to the Pleistocene age.

(*To be continued.*)

CORRESPONDENCE.

On the Causes of Earthquakes.

SIR,—The occurrence of an earthquake of unusual violence in England s naturally given rise to very general inquiries and speculations on the ture and causes of these phenomena; and various theories more or less genious, but, for the most part, vague and obscure, have been broached on the subject in the different organs of public instruction.

I have not, however, seen anywhere a notice of that simple, and to my ind conclusive, view of the question which I have put forward in my rent work on Volcanos, and I therefore venture to call your attention d that of your readers to it.

I there refer (p. 294) "these sensible vibratory undulations of the earth's rface to the snap and jar occasioned by a sudden and violent rupture of lid rock-masses at a greater or less depth, and probably the instantaous injection into the fissures so formed of intumescent molten matter om beneath." I am happy to find an almost complete accordance beeen this view and that offered by yourself in your last number. But ıen you go on to suggest the sudden crystallization of vast underlying asses of mineral matter as the probable cause of such ruptures in the erlying rocks, I must part company with you. Why should we resort imaginary hypotheses to explain that which, if nature is consistent with rself, is to be simply accounted for by well-known facts? It is certain that e greater number of *volcanic* eruptions are preceded or accompanied by cal earthquakes, evidently caused by the splitting and rending of the cks that form the flanks of the volcano, or the surrounding area, by the pansion and rise of intumescent lava beneath.

In these cases an actual escape of condensed vapour and molten mineral atter does generally take place. Not so, it is true, in the case of other rthquakes, which are usually (not always) felt over more extended areas, d therefore probably proceed from a focus of disturbance more deeply ated, so as not to admit of any outward discharge of erupted matter, seous or fluid, but which, nevertheless, are undistinguishable from the rmer in their *seismic* phenomena, and therefore may well be believed to

* Scheuchzer, Physiq. Sacrée, pl. 48, fig. 18. † Ib., fig. 18, altera.

have the same origin. An earthquake of this latter class I believe, with Mr. Mallet, to be an "incomplete effort to establish a volcano;" that is, the outward escape of pent-up volcanic heat.

In many volcanic mountains we actually see the rents, the "snap and jar" of whose rupture through the solid rocks forming the mountain's side occasioned the earthquake. For instance, during the eruption of Vesuvius in 1860, a violent earthquake-shock was felt along the southern base of the mountain, and a crevice was seen to have opened through its flank behind Torre del Greco, radiating from the side of the eruptive explosions down to the sea, the coast of which was permanently elevated some two feet along a considerable distance. In some of the violent eruptions of the volcanos of Iceland, and also of the Pacific Islands, the mountain has been seen to be split across from top to bottom by such shocks.

The superficial fissures and changes of level which are often observed to accompany earthquakes not attended by outward eruptions, testify to the occurrence of some violent fractures and dislocation having taken place at some depth beneath. Here, then, we have a *vera causa*, seen and known to be at work in many instances, quite sufficient to explain the phenomena of those where the cause is not so apparent, owing probably to the deeper position of the point at which the shock originates. Is it not then, I ask, the most reasonable theory to refer the earthquake to the same primary cause as the volcanic eruption, namely, "the sudden expansion of some deeply-seated mass of mineral matter, owing to increase of temperature or diminution of pressure?" (See p. 296; Volcanos.)

If we suppose the heated matter below the crust of the earth—of the existence of which (at least throughout the great bands of volcanic and seismic disturbance) we have positive ocular proof in its frequent eruptions—to be (as of necessity it must be) exerting a continual upward pressure against the overlying rocks, and creating in them a violent tensile strain, it is certain that any diminution, however slight, in the amount of pressure *above* them—even the sudden lightening of the atmospheric pressure alone—may give occasion to the yielding of the cohesive force of the rocky crust, and its consequent snapping and jarring fracture, to which I attribute every earthquake. Thus is explained the more frequent occurrence of these phenomena at the periods of the Autumnal Equinox, and also when the moon is at the meridian of the locality affected, as shown in the tables of Mr. Perrey and Mr. Mallet to be the fact.

We know that the solid crust of the earth is, and has been from the earliest geological periods, continually undergoing oscillatory movements of elevation or depression. These must have been always accompanied by the fracture and fissuring of its rigid component rocks, at great depths no less than near the surface. Do not these movements correspond with, and amply explain, the frequent occurrence of earthquakes, which are precisely the kind of phenomena we should expect to experience from such sudden and violent snapping and rending of the rocks beneath us? I content myself with this explanation of the cause of earthquakes, and think it quite unnecessary to resort to any other, such as terrestrial electricity, magnetism, crystallization, the breaking-in of the roofs of imaginary subterranean cavities, or the condensation of vapour evolved from submarine volcanos; to which last theory Mr. Mallet, as I think, unnecessarily resorts.

I remain, Sir, your very obedient servant,

G. POULETT SCROPE.

London, 20th November, 1863.

[The late date at which Mr. Scrope's letter arrived, precludes the possibility of my noticing at any length his very valuable communication. The experience of Mr. Scrope, and his indefatigable and acute observation of volcanic phenomena, over a period of many years, entitle his opinions to the most marked respect, and his excellent works on the subject have always excited my admiration. His views, to which he recalls my attention, had escaped me at the time of writing my article in the November number; but I made no reference to any authors or any published views, because I simply wished to put forward what I only regarded as a speculative idea, whether the crystallization of vast rocks could give rise, by their expansion or contraction, to the rupture of rock-strata not necessarily in immediate contiguity with the crystalline mass, but held in a state of tension by the difference in volume produced by crystallization. Mr. Scrope has misunderstood me altogether in supposing I meant a *sudden crystallization:* what I meant was, that the "*snap*" of the rock-strata, held in tension by the increased or diminished volume of the crystalline mass, was *sudden*. The crystallization of rock-masses I believe to be very slow, perhaps often occupying enormous periods of time to effect over great masses. Still, however slow the alteration of volume takes place, a tensile strain must be continuously accumulating until it exceeds the adhesive force of the strata, and then a "snap" occurs. I also referred in my remarks only to such earthquakes as occur without visible or evident association with active or eruptive volcanic phenomena; such, for example, as the late English earthquake, or those so constantly taking place in the neighbourhood of Comrie, in Scotland. It seems to me that there are two classes of earthquakes, one connected with volcanic phenomena, as stated by Mr. Scrope, the other, simply "snaps and jars," without any connection with volcanic phenomena at all, and produced by the crystallization, the drying and contracting, or increase of volume by heat or other suchlike natural causes which are not dependent on subterranean volcanic materials, such as molten lava or the supposed incandescent internal fluid core of our earth. I put forth the idea of crystallization as one of the possible causes of what I supposed to be non-volcanic earthquakes, with some timidity, knowing and appreciating the labours of Mr. Scrope and Mr. Mallet, and the more so that I had had little time to devote to the due consideration even of my own idea. I thought it one, however, worth promulgating, and I am gratified to read the terms in which Mr. Scrope speaks of it. —Ed. Geol.]

Mammalian Remains from Grays Thurrock.

Sir,—With a view to the settlement of some undecided points connected with the "mammalian fauna" of the pre-glacial deposit, and of the post-glacial high and low level gravels, etc., any geologists or palæontologists possessing collections from Grays Thurrock, or any of the other fossiliferous localities in the valley of the Thames, or corresponding river-valleys in the south-east of England, will greatly oblige the undersigned, by communicating to him whether they possess good specimens, containing teeth, of bears, or of hyænas; and if so, what amount of evidence the specimens present.

H. Falconer.

21, *Park Crescent, Portland Place, Nov.* 12, 1863.

Mammoth Remains at Leicester.

Dear Sir,—As it is of importance in these "drift-searching" days that all remains found of mammals in the drift should be made known to your readers, I have much pleasure in communicating to you that information was this morning brought me of a horn or tusk, of very large dimensions, had been laid open in a cutting for drainage in the valley of the Soar, in the outskirts of Leicester, and near the village of Belgrave. I at once proceeded to the President of our Philosophical Society, and obtained his permission to secure it for our town museum; and also to inform one of our leading geologists, James Plant, Esq., of the fact. We drove to the spot, and found our anticipations more than realized; for it turned out to be the tusk of a "great Mammoth," such as is very rarely found in this country.

The specimen is in a fine state of preservation, and measures 2 feet in circumference, and 9 feet in length. It lay at the bottom of a very old drift-gravel, and on the true bed of the Keuper marl, at a depth of 11 feet from the surface.

It is very interesting to find Mammoth bones on the virgin-surface of an old formation, as it establishes to my mind, beyond a doubt, the existence of the Mammoth before the "drift."

Some have doubted whether the Mammoth really was an inhabitant of this country; but this has been long set at rest; and here is undoubted evidence of the fact of its local existence. The specimen is very little water-worn.

I do not know that any further remarks are necessary. The specimen in the course of this day will be lodged in the Leicester museum.

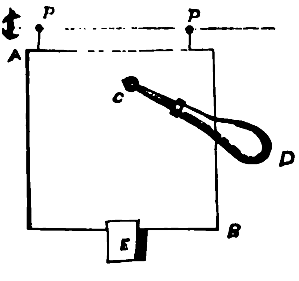
I am, dear Sir, yours very truly,

FRANCIS DRAKE, F.G.S.

30, *Market St., Leicester, 27th Oct.*, 1863.

Geological Section Making.

SIR,—Perhaps you may think it worth while to mention in your journal a very simple contrivance which I devised for the purpose of laying down the contour of a piece of ground, of which I desired to make a geological section. From its extreme simplicity, combined with very tolerable efficiency, I think it would often be found useful where mathematical exactness is not required.

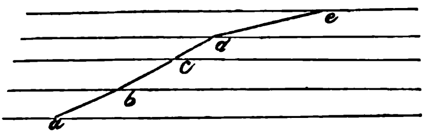


A B is a square piece of board,—accuracy of form is immaterial. It may be of any size, say six inches square. *E* is a piece of lead, bent so as to embrace the lower edge, and capable of being made to slide tightly along it. *D* is an awl passing loosely through a hole at *C*. *P P* are two common pins, stuck into the upper edge of the board.

To adjust this instrument, it is only necessary to slide the weight *E* along the edge of the board, until the heads of the two pins rest in a horizontal line, when it is suspended by the handle *D*. This may be done either by fixing a mark at the level of the eye, and looking at it from a little distance along the line *P P*, taking care that the feet are on the same level as when fixing the mark, which may be ensured by standing on the shore of a pond or the sea; or else the adjustment may be effected by sliding the weight until the *same* point of a distant object is seen along the line *P P*, when the two pins are interchanged by bringing first one and then the other next the eye.

The proper position of the weight having been determined, the instrument is ready for use.

Suppose the contour of a hill desired. Take your stand at the lowest point at which the section is required to commence; hold one of the pinheads near the eye, and notice the point in the hillside where the line *P P* falls; pace to the spot, and note down the number of steps. Start afresh from that point to the next similarly determined, and again noting the number of steps; and so on. Thus on your note-book you will have entered a series of numbers; and that, in each of the intervals so noted, you have ascended by the height of your own eye above the point at which you started. Should the hillside be too steep to pace it, a measuring tape may be used. By ruling on a piece of paper parallel lines at the distance of the height of your eye to the scale you wish to use, it is extremely easy to lay down the contour of the hill from these notes.



I remain, Sir, faithfully yours,
O. FISHER.

Elmstead, Colchester, November 3rd, 1863.

BRITISH ASSOCIATION MEETING AT NEWCASTLE.

(*Continued from p.* 395.)

ON SOME FOSSIL AND RECENT FORAMINIFERA COLLECTED IN JAMAICA BY THE LATE MR. LUCAS BARRETT, F.G.S.

BY PROFESSOR T. RUPERT JONES, F.G.S., AND W. K. PARKER, ESQ.

In 1862 Mr. L. Barrett, F.G.S., late Director of the Geological Survey of the West Indies, gave Messrs. Jones and Parker some fossil and recent Foraminifera from Jamaica, comprising a few new forms—some that were previously but little known, and some in finer condition of growth than usual. The recent specimens, from their ascertained habitats, illustrate, to some extent, the conditions under which the fossil forms were deposited.

One sample of these fossil Jamaican Foraminifera consisted of several specimens of *Amphistegina vulgaris*, and another of a few of the same species, with one *Textularia Barrettii* (a new variety of *Textularia*). No locality nor geological horizon was indicated for these. A third sample, from "South Hall Cliff," consisted of two large specimens of *Vaginulina legumen*. Fourthly, a much larger series of Foraminifera, from the "Pteropod-marl" of Jamaica, affords *Nodosaria Raphanistrum, Dentalina acicula, Vaginulina striata, Frondicularia complanata, Cristellaria calcar, C. cultrata, C. rotulata, C. Italica, Orbitolina vesicularis, Bulimina ovata, Cuneolina pavonia, Vertebralina striata,* and *Lituola Soldanii*. These, however, can be regarded only as an incomplete Rhizopodal fauna.

From the recent Foraminifera obtained by the late Mr. Barrett from different sea-zones, between 15 and 250 fathoms, on the Jamaica coast, we learn that *Amphistegina vulgaris, Textularia Barrettii, Dentalina acicula, Frondicularia complanata, Cristellariæ*, and *Lituola Soldanii* indicate at least 100 fathoms, and probably more, as the depth at which the Pteropod-marl and the Amphistegina-beds were deposited in that region. Pteropods are found in some sea-muds at similar depths.

Of the recent Jamaican specimens (evidently only the larger and more conspicuous members of a rich Rhizopodal fauna), some were taken at from 15 to 20 fathoms, namely, *Quinqueloculina agglutinans*, *Q. pulchella*, *Orbiculina compressa*, and *O. adunca*; some at from 50 to 100 fathoms, namely, *Orbiculina compressa*, *Dentalina acicula*, and *Orbitolina vesicularis*; and several others at from 100 to 250 fathoms, namely, *Dentalina acicula*, *D. communis*, *Cristellaria rotulata*, *C. cultrata*, *C. calcar*, *Frondicularia complanata*, *Amphistegina vulgaris*, *Polytrema miniacea*, *Bigenerina nodosaria*, *Verneuilina tricarinata*, *Textularia trochus*, *T. Barrettii*, *Cuneolina pavonia*, *Lituola scorpiurus*, and *L. Soldanii*.

Cuneolina, a rare form, hitherto known only by figures, and description given by D'Orbigny, proves (as suspected) to be a modification of *Textularia*; and *T. Barrettii* is intermediate between it and *Textularia* proper. The *Frondiculariæ* are remarkably large and beautiful; and the *Cristellariæ* and *Dentalinæ* are also large and relatively abundant.

This fauna is almost identical with the fossil Foraminifera of the Tertiary "Pteropod-marl" of Jamaica, above mentioned, specimens from which also were given by the late Mr. Barrett in 1862 to the authors of this notice.

ON THE BIVALVED ENTOMOSTRACA OF THE CARBONIFEROUS STRATA OF GREAT BRITAIN AND IRELAND.

By Professor T. Rupert Jones, F.G.S., and J. W. Kirkby, Esq.

(*Read before the British Association, at Newcastle, September*, 1863.)

After a review of what former observers have published on the Bivalved Entomostraca of the Carboniferous formations, the authors proceeded to point out—1st, a few rather doubtful *Cyprides* or *Candonæ*, from the coal-measures. 2ndly, *Cytheres*; of which there are about eight species, chiefly from the coal-measures. 3rdly, *Bairdiæ*; about eight species, mostly from the mountain-limestone and its shales. 4thly, *Cypridinidæ*; comprising *Cypridina*, *Cypridella*, *Cyprella*, *Entomoconchus*, and *Cytherella*, from the mountain-limestone; a fine collection of these rare forms from Little Island, Cork, liberally placed at Messrs. Jones and Kirkby's disposal by Mr. Joseph Wright, well elucidate the relationships of these hitherto obscure genera and their species. 5thly, *Leperditidæ*; comprising *Leperditia* (to which genus belong the so-called *Cypris Scotoburdigalensis*, *C. inflata*, *C. subrecta*, *Cythere inornata*, and others; many of them dwarf varieties of one species, and mostly belonging to the mountain-limestone series); *Entomis* (mountain-limestone), Devonian and Carboniferous forms of which have been mistaken for *Cypridinæ*; *Beyrichiæ* (from nearly all parts of the Carboniferous system), several species, of which *B. arcuata*, Bean sp., is the most common; and *Kirkbyæ*, somewhat rare, and chiefly from the mountain-limestone series.

Leperditia and *Beyrichia* are also Silurian and Devonian genera; they do not appear to pass upwards into the Permian formation. *Bairdia* and *Kirkbya* occur first in the Carboniferous, and reappear in the Permian deposits, even in the same specific forms; and *Bairdia* has been freely represented in Secondary and Tertiary deposits, and exists at present. Of the *Cypridinidæ* under notice, *Cypridella*, *Cyprella*, and *Entomoconchus* appear to be confined to the mountain-limestone; *Cypridina* occurs in the Permian, and with *Cytherella* is found in Secondary and Tertiary rocks, and in existing seas. *Entomis* is a Silurian and Devonian genus, especially characterizing the so-called "Cypridinen-Schiefer" of Germany.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

LIVERPOOL GEOLOGICAL SOCIETY.—Amongst the papers of the last session are :—"On the Ancient Glaciers of Snowdon," by Mr. G. H. Morton, who gives an account of the experiences of two days spent on the mountain, and describes the group included under that name,—the highest peak, Pen Wyddfa, being 3571 feet above the sea. "On the Lingula-flags and Strata beneath," by the same author, who describes at considerable length the principal localities in Europe and North America where the Lingula-flags and Lower Llandeilo strata are developed, and in conclusion, states that "the fossils of the Lingula-flags embraced many varieties of form, and that though there are cosmopolitan species, there are others of more limited range in space. The result of geological investigation in the Cambrian rocks has brought to light but very scanty traces of early life, it being only in the strata of that age, at Church Stretton and Bray Head, that any such indications have been found. It is, however, remarkable that crystalline limestone should occur in the still lower Laurentian system, for if this rock was formed, like other limestones, of comminuted fragments of shells and corals, since altered by a high temperature, then the theory of such rocks being *azoic* is groundless, and we have yet to become acquainted with the most ancient life-creation."

Report of the Field Meeting at Storeton, on Monday, the 7th of July, 1862,—when Mr. Morton exhibited for the first time a section drawn to scale, showing each important bed that occurs in the oldest of the Storeton quarries—the south quarry. The interesting faults, and the position of the Keuper Sandstone, in a fissure of the Bunter Sandstone, cause this section to be very remarkable and instructive.

A field meeting was held at Leasowe, September 20th, 1862, when the members visited the interesting sections of the submarine forest beds at Leasowe Lighthouse and Dove Point.

"On the Geology of the Thames Valley." By Mr. W. S. Horton, F.G.S. The physical features of the district consist of a succession of low terraces overlooking the valley of the Thames, or Isis, presenting to the course of that river their more abrupt flanks, and gently sloping down in the opposite direction. This terrace-like succession is a true index to the stratigraphical structure of the district, as it will be found that each of them is composed either of limestone or some other firm rock, resting upon a basis of clay, which forms the intervening valley. The formations occupying the tract of country described in this paper are in descending order; the Post-Pliocene (represented by the high-level gravel and the estuarine, or low-level gravel); the Lower Cretaceous (the Shotover Sand and Lower Greensand); and the Upper and Middle Oolites, consisting of the Purbeck beds, Portland Stone and Sand, Kimmeridge Clay, Upper Calcareous Grit, Coral Rag, Lower Calcareous Grit, and Oxford Clay. The Oxford Clay occupies a considerable area, extending northward from the ridge of the Coral Rag, but, as for the most part it is level ground, and generally covered by the Estuarine gravel, but very few sections occur. Its thickness is very considerable; at Wytham Hill it was ascertained from a boring to be 600 feet; it is, however, probable that thickness is somewhat exceptional, as at St. Clement's, on the other side of Oxford, it is reduced to 265 feet. Crystals of selenite and iron pyrites occur, but fossils are by no means plentiful, and only locally preserved. The Coral Rag and its associated beds—the Upper and Lower Calcareous Grits—form a low terrace, rising somewhat abruptly from the low ground of the Oxford Clay, and overlooking the valley of the Isis. In a large quarry, at Kingstone Bagpuze, the Upper Grit may be observed resting on the Coral Rag, which in its turn reposes on the Lower Grit. At Wheatley, to the north-east of Shotover, these beds form an anticlinial, or dome, dipping under the Kimmeridge Clay, in every direction from the centre. The Coral Rag, in this neighbourhood, contains its usual assemblage of zoophytes and echinoderms. The Kimmeridge Clay extends along a band of country following the course of the Coral Rag, and resting upon the southerly slope of the terrace formed by that rock. Its organic remains do not offer any important differences from those of the Oxford Clay; indeed, many of them are common to both formations. The best sections of the Kimmeridge are at Headington, near Oxford, and Culham, near Abingdon. The Portland beds extend in a narrow band round the Shotover ridge of hills. At Combe Wood, near Cuddesden, a small patch of Purbeck beds may be observed resting on the Portland Stone. They consist of about four feet of grey marly limestone, containing Cypris, Mytilus, and Paludina. At Culham, the Gault and Lower Greensand may be observed reposing on a base of Kimmeridge Clay. The Gault at this place is a blue laminated clay, with its characteristic fossils, *Ammonites lautus*, *A. interruptus*, *Nucula pectinata*, *Inoceramus concentricus*, and *Plicatula pectenoides*. The Lower Greensand contains no fossils in the neighbourhood of Oxford, but at Faringdon the remarkable gravels of this age are almost entirely composed of sponges, bryozoa, and mollusca. The freshwater sands of Shotover have been the subjects of essays by several writers, who all agree as to their freshwater origin, but are not so unanimous as to their geological date; some being inclined to regard them as being the equivalent of the Hastings Sands, or Wealden beds, and others as an estuarine condition of the Lower Greensand. Professor Phillips is of the latter opinion, and it seems to be the safer course to regard them as an exceptional condition of the Greensand. They contain very few fossils; those that have been collected belong to the genera Paludina, Cyrena, Unio, and Cypris. These beds are valuable, as producing the well-known Oxford ochre. The high-level gravel belongs to the period of the northern drift, and is so called because it occupies the highest ground in the district, as at Wytham Hill, where it attains an elevation of 583 feet above sea-level. It does not contain any organic remains, and is composed of well-rounded quartz pebbles. The low-level gravel is quite distinct in its origin, being formed almost entirely of local rocks, and containing water-worn Oolitic fossils, such as Terebratulæ, and fragments of Belemnites. South of Abingdon, where the surface-rocks are cretaceous, it passes into a flint gravel, evidently derived from the denudation of the chalk of the district. The only remains belonging to the period when it was deposited are those of elephants, probably *Elephas primigenius*. From the position of this gravel, which extends into the valleys of the Windrush and Evenlode, and other tributaries of the Thames, we may conclude that it was formed at a comparatively recent period, when the ridges of Coral Rag were dry land, and what are now river-valleys were a series of shallow lochs, similar to those on the west coast of Scotland.

At the meeting of January 13th, 1863, the President, the Rev. Professor Henry Griffiths, in his Address referred at length to some interesting geological phenomena, peculiar to North and South Wales, with regard to the Old Red Sandstone, and particular attention was drawn to that system of strata. The President then minutely described the series of fossil ichthyolites of that age, lately added to the collection of the Royal Institution.

"On the Wigan Coalfield." By Mr. S. B. Jackson.—The area treated of was illustrated by Farrimond's valuable mining map and list of strata. These served also to indicate the multitudinous "faults" and dislocations of the district, and the "outcrops" of the numerous seams of coal by which it is enriched. The Wigan coal-field contains the lower and middle series of the Lancashire coal-measures. The former are thrown up at Billinge and Up-Holland, present a lofty range of hills, and divide the Wigan from the St. Helen's coal-field. With this exception, the superficial aspect of the region is undulating, and presents no remarkable natural feature. The Millstone Grit constitutes the lowest known rock in the district, and the portion exposed at Grimshaw Delf is about 100 feet thick; resting upon it are the lower coal-measures, 1800 feet in thickness. They consist of a series of micaceous flags, shales, and thin beds of coal, with their floors of underclay, containing Gannister, a peculiarly hard siliceous stone, which, in the first instance, gave the name of "Gannister beds" to the series in which it is found. They contain six seams of coal, designated "Mountain Mines," having an aggregate thickness of about nine feet. Only two of the seams have been found worth working, and those to a limited extent. The sandstones of this series are even-bedded, showing ripple-marks and sun-cracks, and are very extensively used for flagging and roofing-purposes, splitting along planes, formed of micaceous flakes. A good section of the lower measures may be seen in the cutting of the Lancashire and Yorkshire Railway between Pimbo Lane and Up-Holland Stations. Resting upon the micaceous flagstones, just referred to, is the base of the middle coal-measures, which attain a thickness of about 2400 feet. They consist of an alternating series of reddish-grey and yellow sandstone, shales of various character, and beds of coal, with their under clay. This series is the most prolific of coal, containing not less than forty-five seams, with an aggregate thickness of 100 feet. Two-thirds of the number of seams, ranging from two to thirty-two inches, with a total thickness of thirty-three feet, are either impure or too thin to pay for working. The remaining fifteen seams contain about sixty-seven feet of coal, and are those which are exclusively worked in the Wigan coal-field. These range from about two to ten feet in thickness. The properties and qualities of the respective seams of coal differ considerably, as do also remote and detached areas of the same seam. Generally speaking, the whole may be grouped into three classes, viz. the Free-burning, the Bituminous, and the Cannel Coals, of each of which this field furnishes an ample and excellent supply. As a rule, the seams which exceed four feet in thickness are inferior in value to those which are four feet or under, and in most cases the quality near the outcrop is not so good as in the deep. The most valuable seam in this series is the Cannel Coal, and next to it the Orrell Four Feet, or Arley Mine, which at Wigan closely resembles the famous Wallsend of the Newcastle field. This seam being the lowest, is sometimes worked at a great depth. At the centre of the Wigan basin (say under Wallgate), it is about 863 yards from the surface. Our limits preclude a particular description of the several seams. Notwithstanding differences of thickness in strata, and of the quality of the various seams of coal in the two districts, there exist such analogies between the coal-beds of Wigan and those of St. Helen's that miners entertain no doubt of their identity. Indeed, the prevalence of a thick bed of *Anthracosia robusta,* commonly called the "Cockle-shell Bed," occurring upon a substratum of under clay, about sixty feet above the Arley mine, taken in conjunction with the nearness of the Gannister beds below, enables the geologist to identify the strata at the base of the Middle Coal-measures of Lancashire wherever they occur. A series of great "faults," or dislocations, running almost parallel with each other in a N.N.W. direction, and nearly equidistant, divide the coal-field of Wigan into a succession of belts. Minor faults branch away from the main faults in all directions, and break up the strata into numerous subdivisions. Moreover, each fault and branch fault has a certain and considerable inclination to one side or another in its course, varying from one to three vertical to one horizontal. Hence every locality requires to be "proved," either by boring or by the sections of adjacent collieries, so that in sinking a shaft the miner may avoid faults, and "win," at the least outlay, the greater number of seams of coal. The forces which occasioned the dislocations have diminished in power northwards, and the extent of their "upthrows" and "downthrows" vary over the field in question from a few yards to upwards of six hundred. The effect of great upthrows has been the loss of many valuable seams in some localities, and that of downthrows to preserve them, while their combined result has been in one part of the field or another to cause every seam to have one or more "outcrops." The courses of these "outcrops" are clearly traced on the recently-coloured maps of the Geological Survey, and some of the most favourable situations for viewing them, as well as sections of the district, are given in the memoirs of that survey, by Mr. Hull. The coal-bed roofs of the lower measures of Wigan include remains of drifted plants and Sigillariæ, and, in the under-clays, Stigmaria. The "floors," or under-clays of the coal-beds of the middle measure abound with Stigmariæ, or the roots of Sigillariæ, the stems of which occasionally intersect a coal-bed, but are generally found in the roof. Especially is this the case in the roof of the Four Feet Ince Mine, where, from their upright position and ponderous weight, and the nature of the roof itself, they are the frequent cause of melancholy accidents. The coal-beds themselves are vast depositories of fossil vegetation, the forms and tissues of which are for the most part obliterated; but in the roofs are found, beside Sigillariæ, numerous Ferns, Asterophylites, Calamites, Lepidodendrons, and Coniferæ. The fauna of the Lower Coal-measures of Wigan furnish Anthracosia, Modiola, *Goniatites Listeri*, and *Aviculo-pecten papyraceus*. In the roof of the Lower "Mountain Mine" is a fish-bed containing bands, full of Cypris or Cythere, *Microconchus carbonarius*, Anthracosia, and more rarely Goniatites, fish-bones, scales, teeth, etc. The middle series contain *Anthracosia robusta* in abundance, and the varied remains of two fish-beds, one over the Arley and the other over the Cannel mine. From Mr. Hull's memoirs we learn also that the late Mr. Peace, mining-agent to the Earl of Balcarres, collected from the latter bed beautiful specimens of fish, of the genera Megalichthys, Holoptychius, Diplopteris, Ctenoptychius, and some large dorsal rays. Some idea of the immense value of this coal-field may be deduced from Mr. Hunt's Mineral Statistics for 1861. He gives the total quantity of coals raised that year in the United Kingdom as 83,635,214 tons, of which 12,195,500 tons were raised in Lancashire. The number of collieries (not pits) then in Lancashire was 375, the proportion in the Wigan district being 78. An uniform average quantity for each colliery would show the produce of the Wigan coal-field that year to be about 3,000,000 tons. Eight shillings per ton at the pit's mouth,—a low enough estimate for Cannel and all sorts,—would give £1,200,000 as the produce of the mines for one year. The facilities at some of the Wigan collieries for executing extensive orders for shipment in a very short time are surprising. At Rose Bridge Colliery, for instance, the property of Messrs. Case and Morris, Mr. Bryham, the able and obliging manager, states they can raise with ease a thousand tons per day, or fifteen hundred tons in the twenty-four hours, by working night and day.

"On the Geology of the Egyptian Desert." By Mr. H. Duckworth, .G.S.—Egypt, with its desert tracts, covers an area of about 100,000 uare miles. In form it is an irregular parellelogram, the longest axis of hich runs north and south. It is that desert tract, east of the Nile, hich forms the subject of this communication, generally known as the Egyptain Desert," and which, from its connection with the Overland oute and the Suez Canal scheme, has had more than an ordinary amount attention directed to it. The desert which stretches between Cairo and iez is more varied in aspect than those who are acquainted with it might disposed to believe, the ground being everywhere broken up into a series undulating tracts, or shallow ravines, called by the Arabs "Wadis," hilst the mountain ranges of Jebel Mukattam, Jebel Reibun, and Jebel ttakah, form a complete barrier towards the south. The surface of the nd presents generally the appearance of a gravelly beach, pebbles and gular fragments of jasper, chert, quartz, gypsum, and sandstone being gely intermingled with sand. Vegetation is not altogether absent, and the Wadis several ligneous and herbaceous plants are found, among hich are the *Acacia Ægyptiaca*, the *Astragalus hamosus*, and the *Fasia latifolia* (*Sieberi et tumidus*). The height of the desert varies conlerably, but its extreme elevation above the sea may be stated at about 0 feet. Its general character is that of an elevated plateau, rising towards e centre and gradually sinking until it terminates in bold escarpments the banks of the Nile on one side, and on the shores of the Red Sea on e other. These cliffs are composed for the most part of Nummulitic nestone, which we find extensively developed throughout Egypt and ubia and a great part of the Sinaitic peninsula. Overlying this limestone e patches of a sandstone formation, associated with calcareous gypsums id saline marls, and stretching from the Mediterranean Sea far into the ubian and Libyan deserts. The absence of its beds at certain points s evidently been caused by denudation, and the sands and gravels of the sert may be regarded as the débris of this formation. The beds of this ndstone vary in thickness from a few inches to 180 to 200 feet. Silicid monocotyledonous wood is found in great abundance in this deposit, pecially in the vicinity of Cairo, where the remains are so well preserved, id of such magnitude, as to be popularly known as the "Petrified Forest." he wood-stems in question are invariably found in a horizontal position, id there is no evidence to show that they originally flourished *in situ*.

Professor Unger, of Vienna, states that the trees belong, without excepon, to one species, for which he proposes the provisional name *Nicolia Egyptiaca*; and further, that the sandstone in which they occur is strictly ialogous to a formation containing wood-stems near Gleischenburg, in yria. He supposes the masses of wood to have been drifted into a basin parated from the main sea, and filled with water saturated with silica,— hypothesis which appears to me extremely probable.

"On the Composition of Black Sandstone occurring in the Trias around iverpool." By Mr. A. Norman Tate, F.C.S.—These deposits are found the sandstone of Flaybrick, Storeton, Toxteth Park, and other places. ie author's attention was directed to them by Mr. Morton, and he has ice examined them chemically to ascertain their composition. On treatg them with hydrochloric acid, chlorine gas was evolved, and the darkloured portion dissolved, leaving a residue of white sand. A quantitative ialysis showed that, next to silica, the principal ingredient was peroxide manganese. One sample contained as much as 10 per cent. of that subince, whilst in others the quantity did not exceed 3·5 per cent. To the esence of this peroxide of manganese the black colour is evidently due.

It does not exist throughout the entire mass, but merely coats the grains of sand. As far as he had yet noticed these deposits, they appear to occur most frequently in bands of from a mere line in thickness to ¼ inch; but they are also found distributed in patches and small lumps throughout the mass of the rock. In several pieces the black sandstone was distributed much in the same manner as currants in an ordinary cake. The deposits described must not be confounded with other dark-coloured portions of the sandstone. Some sandstones undoubtedly owe their dark colour to the presence of organic matter, derived from the overlying vegetable mould, whence it is extracted by water and conveyed to the rocks beneath. In some dark-coloured sandstones protoxide of iron may also be found.

"Description of the Footprints of Cheirotherium, and of an Equisetum, found at Storeton, Cheshire." By Mr. Morton.—The author referred to the original description of the Cheirotherium footprints found at Storeton, as given by John Cunningham, Esq., F.G.S., in 1838. He proposed the provisional name of *Cheirotherium Storetonense* for the smallest of the following three, from different places in Cheshire,—*Cheirotherium Hercules*, Tarporley; *C. Kaupii*, Lymm; *C. Storetonense*, Storeton. About the time the footprints were discovered, the reed-like stem of a plant was found at the same place. Lithographs of both were published by the late Natural History Society of Liverpool. The fossil reed is now in the museum of the Royal Institution. It has been examined by Mr. F. M. Webb, who described it as the upper portion of an Equisetum, but without any remains of fructification. In Professor Morris's catalogue of British fossils there is no species of the genus, but one from the Keuper of Würtemberg is inserted. The author proposes the name *Equisetites Keuperina*.

"On the Corals of the Silurian Sea." By Mr. Morton.—The author remarks "that if the great development of the septal arrangement in the Zoantharia indicates a higher organization of the polyp, most of the Silurian corals certainly belong to lower forms of that order than those common at the present time. We must, however, remember, that as we find the two suborders, tabulata and rugosa only, in the Devonian, Carboniferous, and Permian systems, it cannot be said that the Silurian differs, except by the addition in its upper strata of Palæocyclus; and if we include that genus in the suborder Aporosa, the coralline fauna as a whole is absolutely higher than that of any other more recent palæozoic epoch. If Palæocyclus really belongs to the family Fungidæ, it is very remarkable that no recurrence of the suborder Aporosa has been noticed until after the close of the Palæozoic period."

"The earliest Llandeilo corals known seem to belong to *Zoantharia tabulata*, and do not differ materially from those of the same suborder in the Upper Silurian. *Pyritonema* is a peculiar genus, while *Heliolites catenularius* occurs from the Llandeilo to the Wenlock strata inclusive. No early examples of *Zoantharia rugosa* have been discovered, and it does not appear that the earliest forms of coralline bodies were the lowest of their order. Few and fragmentary, however, are the corals of the Lower Silurian, and not even a trace has come to light from the still more ancient Cambrian, so that our knowledge after all is very scanty and uncertain about them."

Manchester Philosophical Society.—*October* 20.—"Further Observations on the Carboniferous, Permian, and Triassic Strata of Cumberland and Dumfries," by E. W. Binney, F.R.S., F.G.S. When, in 1848, the red sandstones of the neighbourhood of Dumfries first came under the author's observation, in company with his friend Professor Harkness, doubts came into his mind as to the propriety of their being classed with the Trias, their characters and organic remains clearly indicating more of a Permian age.* Accordingly, in his first paper published on this subject in the Society's Memoirs† in 1855, allusion was made to these beds, and they were classed as Permian after tracking the Permian beds of Lancashire through the north-western counties of York, Westmoreland, and Cumberland. His attention was chiefly directed to the red marls, magnesian limestones, conglomerate, and soft red sandstone strata, those being the common Lancashire types; and where the red sandstones of the neighbourhood of Carlisle and St. Bees were incidentally mentioned, they were treated as Upper New Red Sandstone or Trias, as Professor Sedgwick has described them in his valuable memoir. But in his second communication,‡ published in 1857, where the Howrigg, Shawk, and Westward sections are described, he came to this conclusion that "the brick-red sandstones of those places, with their underlying red clays, as well as the breccia at Shawk, I have little doubt will be proved to be Permian. It is true that no fossil organic remains have yet been found in them, with the exception of the track alluded to in this paper; but if mineralogical characters and geological superposition are to be taken as evidence of their age, they are as good Permian beds as those of West-House, Kirby Stephen, and Brough, in England, and Dumfries and other places in the south-west of Scotland, with the latter of which they are most probably connected."

In a paper published by Professor Harkness in 1862,§ that geologist adopts in substance this view, and agrees with the author's opinion of the Howrigg, Shawk, and Westward red clays and sandstones being of Permian age, and describes a very beautiful section at Hilton, in Westmoreland, which strongly confirms it. Of course, it was not intended to question the Triassic age of the soft red sandstones of Dalston and Holmhead, near Carlisle, which are covered by waterstones, red marls, and lias, as stated in the author's paper on the latter deposit.||

The Shawk sandstones are well seen at Westward Chapel near Wigton, West Newton, near Aspatria, near Allonby, and to the north of Maryport, and after the Maryport, Workington, and Whitehaven coal-field is passed, they appear again to the south on the coast, in the magnificent promontory of St. Bees' Head, and continue southward certainly to Netherton, Seascales, Gosforth, and Drigg Cross, and probably, as Professor Sedgwick suggests, into Furness.

On the north of the Solway the Permian strata on the opposite side of the Vale of Eden are well exposed near Riddings Junction, on the Waverley line of railway, about Carwinlay, Moat, and Canobie, and the range of the Moat sandstone (the same age as that of Shawk) by Glenzier Quarry, Cove, near Kirkpatrick Fleming, above Annan, on to Dumfries, is well marked.

In addition to a description of several Permian sections at Penton, Riddings, Carwinlay Burn, Barrowmouth, and Ben How, two sections were given, which showed the occurrence of the upper coal-measures, similar to those described by the author some years since in the valley of the Ayr,

* In the 'Quarterly Journal of the Geological Society for 1851,' p. 162, Sir R. I. Murchison doubted the sandstone of Dumfries being of Triassic age, and preferred to class it with the Permian.

† On the Permian Beds of the North-West of England, vol. xii. p. 209, of the Society's Memoirs.

‡ Additional Observations on the Permian Beds of the North-West of England, vol. xiv. p. 101, of the Society's Memoirs.

§ 'Quarterly Journal of the Geological Society for August, 1862,' p. 205.

|| *Ibid.*, for May, 1859, p. 549.

near Catrine, and thus rendering it extremely probable that such coal-measures extend under the valleys of the Eden and the Esk, their southern outcrop being exposed in the Raw Beck, south of Dalston, and their northern outcrop at Canobie. These Carboniferous strata may not be rich in coal, but they contain the limestone of Ardwick, Leebotwood, and Ballochmoyle Braes (formerly termed a freshwater one), and show a great development of coal-measures, which are useful to be known if it be only to show the depth that has to be sunk through before the middle and profitable coal-fields of Whitehaven and Canobie can be reached. This portion of the coal-measures, both in Scotland and the north-west of England, has generally been termed Permian, and summarily dismissed as unprofitable "red measures." In the author's paper on the Ballochmoyle limestone,* it was shown that a great thickness of unprofitable coal-measures had to be traversed before the profitable coal-field at Common could be reached, in that district some 550 yards.

The Canobie section exposes far more coal-measures above the limestone than the one at Ballochmoyle, at least 200 yards, and it shows a passage of Carboniferous into Permian beds, so far as the eye can detect, better than any that has hitherto come under his observation. The strata of these two formations in the bank of the river above the bridge at Canobie from the fine breccia into the underlying clays and shales are most difficult, if not impossible, to separate from the red shales and sandstones seen between that point and the bridge there.

The district about Canobie, Penton, and Longtown, has been described at length by Mr. Edmund Gibsone, in an elaborate and well-illustrated memoir printed in the Transactions of the North of England Institute of Mining Engineers.† In the Penton Linns' section that author describes the mountain-limestone seams of coal, in the Penton railway section the millstone grit series, and in the Canobie coal-field the middle series; and he shows a fault on the south of the latter coal-field which throws the coal-measures down and brings in the Permian strata. All the red measures south of this fault Mr. Gibsone appears to consider Permian, and the fault which brings them in he calls the Great Permian Fault. After examining these red measures, the author said he had come to the conclusion that although a portion of them are Permian strata, as Mr. Gibsone describes them to be, a great part of them are unquestionably upper coal-measures. The profitable Canobie coal-field, like that at Common in Ayrshire, belongs to the middle or valuable coal-field; but there is also at Canobie a great thickness of upper coal-measures containing a seam of limestone, in all respects like the Ballochmoyle Braes, near Catrine, the Ardwick and Leebotwood limestones. Consequently, the Permian fault should be called by some other name, say the Great South Fault.

Practical mining engineers have frequently classed all the red and variegated beds which they find in the upper part of the coal-measures as "red measures" or Permian strata. Now, there is no doubt often great difficulty in drawing the line of demarcation between the upper coal-measures and the Permian strata, and it is possible that, in some sections, one may pass into the other, as appears to be the case in the river-section above the bridge at Canobie, previously alluded to, but in the north-west of England this transition is not generally to be seen. The further we investigate the

* On some Upper Coal-Measures containing a Bed of Limestone, at Catrine in Ayrshire. ('Quarterly Journal of the Geological Society for August, 1862,' p. 437.)

† A geological paper on the Border Districts of Dumfriesshire, Cumberland, and part of Roxburghshire, including the coal formation of Canobie, etc., by Edmund Gibsone. (Vol. xi. p. 65.)

rganic remains of these two formations, probably more genera and species rill be found to be common to both than is at present supposed; but in all ases where the remains of Stigmaria and *Spirorbis carbonarius* (Microconhus) have been found in the strata, the author has termed them Carboniferous. In the absence of organic remains, which is generally the rule and not the exception, the Permian character of the strata has been decided by he mechanical character of the deposits and the order of superposition, he beds of breccia and the soft red sandstone generally affording pretty good evidence of the Permian age of the strata over a great extent of country, and varying with the character of the older rocks found *in situ* in the listrict. If the Permian beds are taken as the Moat sandstone, the red shales rith gypsum and four breccias lying in soft red sandstone at Canobie and Riddings, their identification is pretty easy; but in continuing them lownwards into the upper coal-measures, or in tracing their boundary upvards into the Trias, there is greater difficulty, as natural sections showing he passage of one into the other are not often with; but he considers the oft red sandstone of Longtown, West Linton, Rockliffe, and Dalston to be of Triassic age, and covered by the waterstones and red marls of Carlisle, and these, in their turn to the west, overlaid by the lias of Quarry Gill and Oughterby.

The Knotty Holm sandstone and a similar rock at Penton, especially in heir lower portions, reminded the author of the Whitehaven sandstone, and it is possible that they may be of the same geological age as that rock, but for the present he has included them in the upper coal-measures.

In the valleys of the Esk and Liddel he described some interesting Permian sections, and detailed at length the particulars of the strata found over a distance of above twenty miles from the upper coal-measures at Canobie to the same beds, as seen in the Raw Beck, near Dalston, where the following strata are met with, viz.:—1. Red and variegated clays, 13 ft. 1 in.; 2. Bed of limestone with spirorbis, etc., 1 ft.; 3. Red clays, 10 ft.; 4. Purple shales containing stigmaria, 80 ft.; 5. Soft red sandstone, 10 ft.; 6. Purple shales, 16 ft. 2 in. After tracing the Shawk sandstone by Westward Chapel, Wigton, West Newton, near Allonby, to Maryport, he passed over the West Cumberland coal-field, and followed it by St. Bees to the south of Cumberland, as far as Drigg Cross. He described at length the Permian strata of Barrowmouth and Ben How, south of Whitehaven. At the former place the beds occurred in the following descending order, viz.:—1. Fine-grained red sandstone, laminated and ripple-marked, same as that seen at Moat, Glenzier, Cove, Shawk, Westward, Maryport, and other places, which may be conveniently termed the St. Bees sandstone, fully 1000 ft.; 2. Shaly marls, 30 ft.; 3. Red marls containing granular gypsum, 29 ft. 6 in.; Magnesian limestone of a cream colour, containing shells of Bakevellia and Schizodus, 10 ft. 6 in.; Breccia composed of pebbles of coal-measures, sandstones, and slate rocks, 3 ft.; Red and purple sandstones, 110 ft.; Conglomerate sandstone full of white quartz pebbles, with peroxide of iron and volcanic ash, containing common coal-plants, 30 ft. The two last beds have been long known as the Whitehaven Sandstone, and Professor Sedgwick many years since classed them as Lower Red Sandstone. After further investigation the author is inclined to indorse this opinion, as he cannot find any difference between these sandstones and his Lower Permian beds of Astley, Bedford, and Moira, near Ashby-de-la-Zouch. These singular sandstones lying unconformably to the breccia above and the coal-measures underneath, he thinks will be found to be the English representatives of the Lower Rothliegendes of the Germans.

The author showed that although the upper coal-field of Lancashire and the Midland Counties of England contained several workable seams, the same beds in Cumberland and Scotland contained none. On the other hand, the mountain-limestone series in the latter districts contained numerous seams of coal, whilst none were to be found in the former.

GEOLOGICAL SOCIETY.—*November 4th*, 1863.—1. "On some Ichthyolites from New South Wales sent over by the Rev. W. B. Clarke, F.G.S." By Sir P. de M. Grey Egerton, F.R.S.

Two specimens and three photographs, sent to England for the author's determination, enabled him to distinguish four genera, two of which are new, and allied to Acrolepis and Platysomus respectively; the known genera being Urosthenus, *Dana* (allied to Pygopterus), and Palæoniscus, *Agass.* Sir Philip was of opinion that these genera were sufficient to stamp the deposit in which they occur—namely, the coal-formation of New South Wales—as belonging to the Palæozoic period, if they may be regarded as representative genera living at the same period as, but geographically distant from, their nearest allies; but, as regards the actual age of the formation, the allied genera are more abundantly represented in the Magnesian Limestone and the Kupferschiefer than in the coal-measures; the materials were, he considered, too meagre to justify a conclusion.

2. "Notes on the Geology of a portion of the Nile Valley north of the Second Cataract, in Nubia, chiefly with the view of inducing further search for Fluviatile Shells at High Levels." By A. Leith Adams, A.M., M.B., Surgeon 22nd Regiment. With a Note on the Shells, by S. P. Woodward, Esq., F.G.S.; and a Note on some Teeth of Hippopotamus, by Hugh Falconer, M.D., F.R.S.

In company with the late Mr. A. H. Rhind, F.S.A., the author made the usual boat-voyage from Cairo to the Second Cataract during last November and the two following months, when he was enabled to make some observations on the geology of that portion of the Nile valley. In this paper he first described the physical features of the district, beginning at Selsileh and proceeding southwards, and then the lithological and stratigraphical characters of the Nile sandstone, as well as its mode of junction with the granite, noticing also the evidences of the Nile having shifted its bed, and of other physical changes occurring in Nubia. Near the Second Cataract were abundant proofs of the river having formerly flowed at higher levels, the author having found river shells, such as *Cyrena fluminalis*, *Paludina bulimoides*, *Iridina Nilotica*, and *Œtheria semilunata* (the Nile oyster), as also *Bulimus pullus* and a Unio like *U. pictorum*, in beds of alluvium on elevated plateaus at various heights, ranging up to 130 feet, above the highest inundations of the present day.

Dr. Adams concluded from these facts that the Nile was formerly a more rapid river than it is now, and that the force and wearing power of the stream has been steadily declining since the upheaval of the valley ceased.

The determinations of the shells were made by Mr. Woodward, who gave a complete list of them in a note. Dr. Falconer also described two molars embedded, *in situ*, in a fragment of the left maxillary of a very large hippopotamus; the specimen was dug up near the old temple of Kalábshe, in Nubia; and Dr. Falconer was of opinion that it belonged to the same species as the existing hippopotamus of that country.

November 18.—1. "On the Fossil Corals of the West Indies."—Part II. By P. Martin Duncan, M.B., F.G.S.—This communication consisted chiefly of a description of corals returned to the Society's Museum by Mr. Lonsdale soon after the reading of the first part.

The predominance of simple fossil corals in San Domingo, and their complete absence in Antigua, were pointed out; and it was remarked that the same kind of distribution occurs at the present day, pedunculated compound forms being very common around the northern Antilles, but rare around the north-eastern, although the corals are mostly of different genera to those found in the fossil state. The author concluded with some remarks on the physical conditions of the Miocene period in the West Indies, observing that the Nivaje shales and associated deposits are the remains of an ancient barrier-reef, and giving an analytical table of the affinities of the species, in which it was shown that the Pacific and East Indian element greatly preponderated.

2. "Notes to accompany some Fossils from Japan." By Captain Bullock.—There having been no geologist attached to the late surveying-expedition of H.M.S. 'Dove,' the commander of that vessel endeavoured to repair the deficiency, so far as his professional duties would allow, by collecting fossils, and recording their localities. The specimens were presented to the Geological Society.

3. "On some Miocene Mollusca from Mount Séla, in the Island of Java." By H. M. Jenkins, Esq., F.G.S. With a Description of a new Coral from the same Locality, and a Note on the Scindian Fossil Corals. By P. Martin Duncan, M.B., F.G.S.—A short notice of the scanty literature of Javan geology having been given, the author described briefly the geological and physical features of the Mount Séla district, and made some general observations on, and gave descriptions of, the fossils which were the subject of the paper, and which had been sent to England by M. Corn. de Groot. Of sixteen determinable species, only three are now known to exist, the remainder being new species; but the fossils were probably more recent than this small percentage of living species would appear to indicate, there having occurred an emigration eastward of at least a part of the Southern- and Middle-European Miocene and Eocene fauna, as was proved by the identity of many species in the European Miocene, which now exist in the eastern seas, and also by certain genera being represented in that formation and the Eocene, and confined in the living state to the Indo-Pacific region. One of the Javan species being closely related to *Vicarya Verneuilii* from Scinde, the author was induced to investigate the claims of the Nummulitic formation of India to be considered altogether of Eocene date; and he inferred that there was a probability of some of the beds belonging to a less remote period. This inference was supported by Dr. Duncan in a Note upon the Scindian Fossil Corals, many of which (unnamed by M. Haime) were shown to have Miocene and recent, but not Eocene, affinities. The author next referred to the diminutive character of many of these Javan fossils, and then reviewed the opinions of former writers upon the Tertiary formation of that island, coming to the conclusion that the Mount Séla shells were probably of late Miocene date, and that the plants described by Dr. Goeppert were probably newer than the Eocene. The fossil coral from Mount Séla was shown by Dr. Duncan to be allied to *Astræa quadrangularis*, the habitat of which is unknown.

FOREIGN INTELLIGENCE.

The shores of the Caspian Sea had been shaken by frequent and violent earthquakes and eruptions during the early months of 1859, when Captain Kumany and Lieut. Petrof, of the Russian navy, discovered that a new island had been raised in that sea.* Mr. Abich visited the island on June 20th, 1859, and found that it had an elliptical shape, between 400 and 500 paces in circumference, very slightly convex, and with a small loamy flat area, bearing round shallow pools of water, kept in continual motion by the rising of gas-bubbles. The island was then 286 feet long and 225 feet broad. Its height (found by Captain Kumany to be 18 feet) had already lessened to 11⅓ feet. At the end of July it was only 6 feet high; and in November it had disappeared below the sea-level. In 1862 there was an increasing depth of water at the place; and in January, 1863, there were 12 to 13 feet of water there. Mr. Abich proposes that the island should be known as Kumany Island, in honour of the officer who first ascertained its existence.

The island had risen from a flat sea-bottom of sandstone and marl, in 75 feet depth of water, and 1000 feet from the shore. The eruptive action had evidently worked directly upwards through a conical accumulation of mechanically divided rock-substances, altered hydro-chemically, and such as might be derived from the sandy and gritty members of the molasse formation that exists on the neighbouring shores of the Caspian. According to Captain Kumany, the materials of the newly-raised island were tough and very hot, the temperature increasing with the depth. Mr. Abich found the island to have a temperature of 28°·4 R. (95°·9 F.), the atmospheric temperature being 20°·3 R. (77°·6 F.). By his further investigations, including chemical analysis, Mr. Abich finds that the muddy lavas of the Caspian region show evident analogies with certain tufaceous rocks of southern Italy; and that those of them which are insoluble in hydrochloric acid correspond to the normal siliciferous eruptive trachytic porphyries of Armenia and the Ponza Islands. He thinks that probably a formation of such porphyries, overlaid by sediments, extends over the central area of the Caspian Sea, and that the muddy lavas originate from a kind of trachytic tuff, forced upwards through vein-like fissures. The existence of two systems of fissures, intersecting each other at oblique angles, appears evident to Mr. Abich from the situation of the insular mud-volcanos in the Caspian, of the islands raised from its bed, and of the fumaroles, naphtha-springs, and mineral waters on its shores, by the lines of earthquake-shocks (Alat, in the summer of 1860), and by a vein of substances, analogous in composition to the mud-lavas of Kumany Island, filling a crevice in a valley of elevation near Teflis.

A piece of yellow amber,† flattened and round, 3 inches long and about 2 inches broad, found in a Tertiary sand, at about 18 feet beneath the surface, near Polnisch-Ostrau, in Austrian Silesia, is remarkable on account of having its external crust, of a deep honey-yellow tint, completely hardened, whilst its interior, yellowish-white, pellucid, and homogeneous portion still preserved its original soft resinous consistence.

* 'On a Volcanic Island in the Caspian Sea.' By Dr. H. Abich and Director W. Haidinger. (Read before the Imper. Geol. Institute of Vienna, June 16, 1863.) [Communicated by Count Marschall.]

† Director Haidinger, Proceed. Imp. Geol. Instit. Vienna, May 19, 1863.

A well-preserved upper jaw of *Anchitherium Aurelianense** has been lately found in the brown coal of Leiding (Lower Austria); also a tooth, from the lower jaw, in the "marine sands" of Grossbach; and another, from the upper jaw, in the brackish "Tegel" of Nussdorf, near Vienna. This species was long ago stated by the late P. Partsch to occur in the Tertiary limestone of Bruck on Leytha (frontier of Lower Austria); but since that time it had not been met with in the Vienna basin; now, however, it is proved to have lived during each of three mammalian periods, the faunæ of which are found in this basin.†

M. Cornelis de Groot, Chief Engineer and Superintendent of the Dutch Colonial Mines in the East Indies, reports that the production of Tin in Banka and Billiton (Blitong) has been—in the eight districts of Banka—

In 1857...4609·037	Netherland tons,	1000 kilogrammes each.
1858...6028·013	„	„
1859...5686·489	„	„
1860...5175·621	„	„
1861...5406·500	„	„

In Blitong (where M. de Groot first discovered and worked tin-ores in 1851)—

In 1856...209·839	Netherland tons,	1000 kilogrammes each.
1857...114·801	„	„
1858...281·842	„	„
1859...144·404	„	„
1860...249·978	„	„
1861...406·812	„	„

The fossils found at Grand-Manil, near Gembloux, by M. Gosselet, and referred by him to the Silurian period, but disputed by Messrs. Malaise, De Koninck, and Dewalgue as true Devonian, have been admitted by M. Dewalgue, after further researches by M. Malaise, to be Silurian. The genus *Trinucleus* is represented by fragments of *T. seticornis* and *T. Bucklandi*, of Bohemia. A fragment appears to belong to *T. ornatus*. To the genus *Calymene* are fragments of heads, pygidia, etc., nearly allied to *C. incerta*, of Bohemia; to the genus *Lithas* a head complete, analogous to forms of the second fauna of that country. Other fragments belong to the Silurian group of the genera *Encrinurus*, *Chromus*, *Zethus*, and *Endymene*. Lastly, pygidium of *Homalonotus*. This locality also contains Graptolites, which are always regarded as characteristic of Silurian deposits.

M. Belval, Conservator of the Museum of Natural History at Brussels, in classifying the collection of Echinoderms, has come upon a new species belonging to the genus *Encope* of Agassiz, of the class of Scutellæ. It is near to the *Encope Michelini* of Agassiz, figured in pl. vi. fig. 9 and 10, of his Monograph of the Scutellas, but very distinct from all other species of this genus. This new species has received the name of *Encope Ghiesbrechtii*, in honour of M. Ghiesbrecht, the traveller-naturalist, who found it at Pernambuco, in Brazil, and presented it to the Brussels Museum. *E. Ghiesbrechtii* is distinguished from *E. Michelini* by being much larger, and not presenting that augmentation of height so remarkable in *E. Michelini;* the apical rosette is not prominent; the poriferous zones are narrower than the intermediate space.

* Professor E. Suess and Dr. Zittel, Proceed. Imp. Geol. Instit. Vienna, May 19, 1863.
† See 'Geologist,' vol. iv. p. 497; and Quart. Geol. Journ. vol. xvi. Miscell. p. 1.

NOTES AND QUERIES.

Coal-Measures near Shrewsbury.—The geologists of the neighbourhood of Shrewsbury would confer a favour on a correspondent of the 'Geologist,' if they would forward by letter to the Editor, a few small pieces of the shale and limestone of the Upper Coal measures containing the *Cypris inflata*, described by Murchison, in his 'Silurian System,' p. 84, and in 'Siluria' (2nd edit.), p. 322.

British Association Report.—Dear Sir,—In the last part of the 'Geologist' you have made me the author of some remarks on Professor Harkness and Sir Roderick Murchison's paper "On the North-West Permians" (Sec. C. Brit. Assoc.), which were really uttered by Mr. Howse. I made no observations at all on the subject. Will you be good enough to correct the mistake in your next part?

Also in your report of Mr. Atthey's and my paper "On Animal Fossils from the Northumberland and Durham Coal-measures," it is stated that Messrs. Jones and Davidson are of opinion that the fossil from near Claxheugh is not a *Discina*, whereas they are of opinion that it *is* a *Discina*.

Believe me, yours faithfully,
J. W. Kirkby.

Sunderland, 20th Oct., 1863.

Gamahes.—"We have already said that they are found in three sorts of things; in stones, in plants, and in living creatures. Those that are found in stones are called *Gamahes*; a word derived, in my opinion, from Camaïeu, by which name, in France, they call all coloured agates: so that from this particular name there is now made a generall appellation, serving to expresse all sorts of figured stones." . . . "Goropius Becanus, speaking of this kind of *Gamahe*, assures us that he hath seen bones that have been produced naturally within the bowels of the earth, which were of a prodigious magnitude, though they were generated of other matter; and of this kind peradventure are those bones whose vast bignesse hath caused people vainely to conclude that there have beene heretofore gyants in the world; so true it is, that for want of the true knowledge of the secrets of nature, men usually fall into most grosse errors. Now these embossed figures that are found in stones are of two sorts: the first are embossed round, as was the piece of rocke in forme of the Virgin Mary; and those bones that the earth naturally produceth, or only halfe-embossed, such as were those rocks which Ortellius makes mention of, scituate in the entrance of the most western part of Tartary: on which are to be seen the figures of camels, horses, sheep, and many other things, the marvellousnesse whereof this geographer being not able to comprehend, he saies: 'Hæc saxa, hominum, camelorum pecorumque cæterarumque rerum formas referentia, Horda populi gregis pascentes armentaq. fuit: quæ stupenda quadam metamorphosi repentè in saxa riguit, priori parte nullâ in parte diminutâ.' And then, to make the story pass for a truth, he addes: 'Evenit hoc prodigium, annis circiter 300 retro elapsis.'"—*Guffarel.*

Fossil Birds.—The reference at p. 421 for the "head of an owl," in the 32nd line, should be to Pl. XXIV. fig. 1; and the reference at p. 422, line 30, "copied in Pl. XXII. fig. 2, *nobis*," should be omitted. The figure will be given in the next volume. The reference for Buttner's figure of a nest, in the last line of p. 423, should be "Pl. XXIII. fig. 3, *nobis*." The printers have made a presumed emendation at p. 424, after the revises left me for press, which alters my meaning entirely. The prefix "un-" at that page, in line 15, has been in this way put to the word "fortunate." I wish the word to be read as I wrote it, as I do conscientiously think it *fortunate* that we have not been troubled with more of these dendritic markings and fanciful resemblances. On the same page, in line 21, *for* "Fig. 3" *read* "Fig. 2," in reference to Hermann's "head of a goose."

PACHYRHIZODUS GLYPHODON.—The specimen described in Mr. Blake's article, at p. 133, is figured by Mr. Mackie in Pl. XXI.

MISCELLANEOUS NOTICES.

The 'Canadian Naturalist and Geologist' for February contains the first of Dr. Dawson's admirable papers on "Air-Breathers of the Coal Period of Nova Scotia," which are continued through the four consecutive numbers, and have since been published in a separate form. This number also contains papers "On the Gold Mines of Canada and the manner of working them;" "On the Parallelism of the Quebec Group with the Llandeilo of England and Australia and with the Chazy and Calciferous Formations," by Mr. E. Billings; by the same author, a "Description of a New Species of Harpes (*H. Dentoni*) from the Trenton Limestone, Ottawa," and "On the Internal Spiral Coils of the Genus Cyrtina," a new species, *C. euphemia*, being described. The April number contains a "Description of a new Trilobite from the Quebec Group" (*Olenus? Logani*), by Mr. T. Devine; "On the Antiquity of Man,"—a review of Lyell's 'Geological Evidences' and Wilson's 'Prehistoric Man;' "On the Remains of Fossil Elephants found in Canada," by Mr. E. Billings. The remains of the elephant now in the Canadian Geological Museum were found in 1852, at Burlington Heights, near Hamilton, at the western extremity of Lake Ontario, about 40 feet beneath the surface, and 60 feet above the level of the lake. The workmen engaged in making an excavation on the line of the Great Western Railway first cut through 30 feet of stratified gravel, composed of small pebbles of limestone, and so strongly cemented that it could only be removed by blasting. Below this gravel there was met with a deposit of coarse sand, and in this the bones were discovered. The geological age of this deposit is not yet determined with certainty, but is supposed to be that of the well-known lake-ridges and terraces, which were apparently formed just after the close of the upper drift period, and either while the waters of the lake stood at a higher level than they do at present or perhaps while the basin of the lake formed an arm of the sea. The species is named *Euelephas Jacksoni* by Mr. Billings, who says that no remains of man or of his works have been found in the formation which holds the bones of the elephant in Canada. In allusion to the absence of human bones in the ancient river-drift of Europe, he says, "I may mention that for the last fifteen years I have been in the habit of examining the bottom of the Ottawa and other Canadian rivers every season, at the time of the lowest water, in search of fossils, and that, although I have seen the bones of almost all the species of land animals now living in the country, associated with innumerable works of man, I never yet found a human skull in any of these streams. I speak of the skull, because it is possible that some of the small bones may have been those of the human frame and not recognized as such by me. But as man is the only animal who removes the dead of his own species from the water and buries them on shore, thousands of years may elapse without a single skeleton being embedded in a fluviatile formation; and yet the same formation may be full of the traces of his existence, associated with abundant remains of contemporary animals."

The June number contains a paper "On the Superficial Geology of the Gaspé Peninsula," by Mr. Robert Bell, of the Canadian Geological Survey. The Gaspé peninsula embraces the region lying to the eastward of a line drawn across the country, from the head of the Bay of Chalem to about Matan, on the St. Lawrence, and measures a hundred and forty miles in length by seventy in breadth. The superficial accumulations of this district differ in their general character from those of the country to the west, one of the most remarkable points of difference being the absence of foreign boulders. Sir William Logan, the Director of the Geological Survey, contributes one "On the Rocks of the Quebec Group at Point Levis," being a letter, now illustrated by a map, addressed by him to M. Barrande, commenting on M. Jules Marcou's disputations respecting the Taconic rocks of Vermont and Canada. Mr. Sterry Hunt's excellent paper "On the Chemical and Mineralogical Relation of Metamorphic Rocks," read before the Dublin Geological Society on the 10th of April last, is reprinted from the 'Dublin Quarterly Journal,' in this number, as it is also in Silliman and Dana's 'American Journal,' for October. Mr. Billings also furnishes a "Description of a new species of *Phillipsia* (*P. Howi*) from the Lower Carboniferous rocks of Nova Scotia;" and Mr. T. Devine a "Description of a new Trilobite from the Quebec Group (*Menocephalus Salteri*)."

The number for August contains "Observations on the Geology of St. John County, New Brunswick," by Mr. G. F. Matthew, with maps and sections; the rocks in the vicinity of St. John being New Red Sandstone, Carboniferous, Mispeck group, Little River group, Bloomsbury group, St. John's group, Coldbrook group, and the Portland group. There is also the first part of a paper of much interest "On the Origin of Eruptive and Primary Rocks," by Mr. Thomas Macfarlane. This gentleman has, on a previous occasion, published in the same periodical (vol. vii.) a series of papers describing the primitive formations of Norway, and comparing them with their Canadian equivalents. In those essays he abstained altogether from attempting to explain the various phenomena described, although he subsequently appended to them the translation of a chapter from Naumann's 'Lehrbuch der Geognosie,' in which the views entertained by geologists on the subject are stated. One of these theories hitherto most generally adopted supposes the primitive or primary rocks to have resulted from the alteration or metamorphism of sedimentary strata; another supposes them, in part at least, to represent the first solidified crust of our planet. Although these opposing theories might with justice be termed respectively the aqueous or metamorphic theory and the igneous theory, such names must not be regarded as having connection with the old theories of the Neptunists or Plutonists. Indeed, instead of there being any analogy with the old controversy, Hutton himself was the founder of the Plutonic school of former days, and the originator of the theory at present in favour, of the aqueous origin of the primary stratified rocks. On the other hand, it is scarcely possible to say who was the author of the igneous, although the writings in which it was propounded are of comparatively recent date. Mr. Macfarlane names Sir Henry De la Beche amongst its earliest supporters, and quotes the following passage from the 'Report on the Geology of Cornwall:'—"If we consider our planet as a cooling mass of matter, the present condition of its surface being chiefly due to such a loss of its original heat by long-continued radiation into the surrounding space, that from having been wholly gaseous, then fluid and gaseous, and subsequently solid, fluid, and gaseous, the surface at last became so reduced in temperature, and so little affected by the remaining internal heat, as to have its temperature chiefly regulated by the sun, there must have been a time when solid rock was first formed, and also a time when heated fluids rested upon it. The latter would be conditions highly favourable to the production of crystalline substances, and the state of the earth's surface would then be so totally different from that which now exists, that mineral matter, even abraded from any part of the earth's crust which may have been solid, would be placed under very different conditions at different periods. We could scarcely expect that there would not be a mass of crystalline rocks produced at first, which, however they may vary in minor points, should still preserve a general character and aspect, the result of the first changes of fluid into solid matter, crystalline and subcrystalline substances prevailing, intermingled with detrital portions of the same substances, abraded by the movements of the heated and first formed aqueous fluids." Although the language is somewhat indefinite, the igneous theory is shadowed forth in it, and this quotation may be considered as the text of Mr. Macfarlane's present Essay, in which he maintains that there is every appearance of reason for considering that the primitive Gneiss formation constitutes the first solidified crust of the originally-fused globe, and that the crystalline and subcrystalline rocks of the Primitive Slate formation are the products of a peculiar transition period, during which aqueous fluids gradually accumulated on the surface, and the latter attained a temperature approaching somewhat to that of the present day. This number also contains a short but able article by Mr. T. Sterry Hunt, "On the Earth's Climate in Palæozoic Times." Referring to our own Tyndall's wonderful experiments on the relation of gases and vapours to radiant heat, he shows their important bearing upon the temperature of the earth in former geological periods. Aqueous vapour, like a covering of glass, allows the sun's rays to reach the earth, but prevents, to a great extent, the loss by radiation of the heat thus communicated:—"When however the supply of heat from the sun is interrupted during long nights, the radiation which goes on into space causes the precipitation of a great part of the watery vapour from the air, and the earth, thus deprived of this protecting shield, becomes more and more rapidly cooled. If now we could suppose the atmosphere to be mingled with some permanent gas, which should possess an absorptive power like that of the vapour of water, this cooling process would be in a great measure arrested, and an effect would be produced similar to that of a screen of glass; which keeps up the temperature directly beneath it by preventing the escape of radiant heat, and indirectly by hindering the condensation of the aqueous vapour in the air confined beneath. Now we have only to bear in mind that there are the best of reasons for believing that during the earlier geological periods, all the carbon since deposited in the forms of limestone and of mineral coal existed in the atmosphere in the state of carbonic acid, and we see at once an agency which must have aided greatly to produce the elevated temperature that prevailed at the earth's surface in former geological periods. Without doubt, the great extent of sea, and the absence or rarity of high mountains, contributed much towards the mild climate of the Carboniferous age, for example, when a vegetation as luxuriant as that now found in the tropics flourished within the frigid zones; but to these causes must be added the influence of the whole of the carbon which was afterwards condensed in the form of coal and carbonate of lime, and which then existed in the condition of a transparent and permanent gas, mingled with the atmosphere surrounding the earth, and protecting it like a dome of glass. To this effect of carbonic acid it is possible that other gases may have contributed. The ozone, which is mingled with the oxygen set free from growing plants, and the marsh gas, which is now evolved from decomposing vegetation under conditions similar to those then presented by the coal-fields, may, by their great absorptive power, have very well aided to maintain at the earth's surface that high temperature the cause of which has been one of the enigmas of geology."

REVIEWS.

The Geology of the Country round Liverpool. By Geo. H. Morton, F.G.S.

Towards the close of 1861 a lecture was delivered to the Liverpool Naturalists' Field Club by the author, "On the Geology of the Country round Liverpool," which the Council of that Institution at once decided to publish. Since that period the author has re-surveyed and confirmed his original investigations, and otherwise matured and improved his work for presentation to the public. Ten years ago the subdivisions and superposition of the Triassic rocks in this district had not been determined, although Mr. Cunningham had as early as 1838 made known the occurrence of fossil footprints in the strata of the Storeton quarries; and it was not until Mr. Hull, who had then just completed his examination of the district for the Government Geological Survey, read a paper on the results of his labours before the British Association in 1854, that the details of these important beds were published. The book before us gives a concise and admirably clear account of the Liverpool district, commencing with the physical features of the country and the geological systems and formations exhibited to obtain it. These consist of the coal-measures, and Trias, and Pleistocene deposits, including boulder-clay, and submarine forests. The faults, denudations of the beds, and general geological history of the district, are also treated with accuracy and perspicuity of description. The numerous plates and woodcuts give well-selected examples of fossils and geological and physical phenomena. These include a view of the submarine forest of Leasowe at Dove Point, sections from the river Dee to Hayton, of the strata round Liverpool, through the coal-measures at Prescot, of the Lower Soft Red and Variegated Sandstone at Toxeth Park; of the pebble-beds at Eastham, through Fairbrick and Bidston Hills, showing the junction of the Upper Soft Red and Variegated Sandstone with the overlying Keuper Sandstone, of the Keuper at Liverpool and Wirral, of the strata along the three railway tunnels under the town, through the Lower Keuper at Storeton, across Wallasey Pool showing the submarine forest bed, along the Cheshire coast, from the lighthouse, Dove Point, Leasowe; and plates of the footprints of the *Cheirotherium*, *Rhynchosaurus*, and other fossils. The accounts of the post-glacial deposits are exceedingly interesting. The elevated ridges of sandstone traversing the district from north to south are generally free from drift, while the depth of the intervening valleys had been diminished by thick accumulation. The river Mersey occupies what was once the deepest of these valleys. From his examination of the shores, Mr. Morton considers the on of the rocks to be naturally low, and that though there have been ontories of rock at Dingle, New Brighton, and Eastham, as also of ler-clay at Egremont and other places, these never extended any distance. In most places the land slopes gradually towards the ·, from which Mr. Morton concludes that a wide low valley existed at nd of the glacial epoch, and considers his conclusion confirmed by xistence of the submarine forest beds so frequently described by au- . The sections and strata prove, he thinks, that a subsidence of about feet has taken place, there being several successive old forests or land ces, with silt between the oldest of them, overlying the boulder-clay. g the coast from Crosby to Liverpool there are indications of the est-bed" which dips considerably in the valley of the Mersey, being y-five feet below high-water mark at the North Docks, near Bootle, e the section in descending order is—Sand, Blue Silt, Peat, or Forest- resting on sandstone. In 1829, a section was exposed in excavating e Old Dock and gave

	High-water mark.
19 feet	Water.
3 feet	Dock Silt.
	White Sand.
6 feet	Blue Silt.
1 foot	Peat or Forest bed, with trunks of trees.
10 feet	Blue Silt, with stags' horns.
1 foot	Peat or Forest-bed, with trunks of trees.
	= 40 feet.
	SANDSTONE.

her sections are given, some of which may still be visited. The whole has now been converted into docks, it being during their construction the opportunities for examination occurred, for ten years ago vessels l over the place, and now are moored in deep water there. It will be seen, Mr. Morton says, "that the pool occupies an ancient valley, bottom and sloping sides of which were covered with trees." "The y ofttimes became filled with water, and a deposit of mud formed over bed of the pool, ten feet thick in the middle, and gradually thinning t the sides;" "originally the submarine forest bed at the bottom of the y would have been connected with the present surface of the land, the continuation has been broken away by denudation along the sides e pool." "The trees grew immediately above the boulder-clay, their s and two or three feet of their trunks remaining *in situ* until torn up ie excavators." In the silt over the forest-bed a human skull and bones, isted with zoophytes and barnacles, were found by Mr. T. J. Moore, Curator of the Liverpool Museum, and described by him in the tenth me of the 'Transactions of the Historic Society of Lancashire and hire.' Amongst the mammalian remains were bones and horns of *primigenius*, *B. longifrons*, *Cervus elaphus*, and rib-bones of a ceta- . The Dove Point portion is very interesting, and the forest-bed may e be examined,—the old land-surfaces one over the other "indicating es in the subsidence, and each covered by accumulations of silt depo- during the gradual sinking of the land." The lowest forest-bed here ght feet below the level of an ordinary spring tide. Approaching the ankment from Dove Point, the two lower forest-beds gradually amal- ate, and then are both merged into one, the three feet of intervening silt ng entirely thinned out. "The surface of the boulder-clay upon which owest bed rests at Dove Point forms a depression; a gradual subsidence seems to have caused an eruption of the sea over the low-lying land, which then silted up the hollow; and a new forest, of more noble growth than the former one succeeded. This forest was afterwards destroyed, though hundreds of the roots and small portions of the trunks of trees still remain exposed on the shore. On the old land-surface, but not below it, have been found implements, ornaments, and coins of Roman, Saxon, and early English manufacture. Another bed of silt—a bluish mud—next occurs; then a bed of peat which, though it may be co-ordinated with the present surface, where not covered by drift sand, shows clear evidence of having been subject to inundations, for there is a bed of black sandy earth above it, containing, in addition to the common shells of the district, teeth of the ox, and the leaves and twigs of trees, being a comparatively recent deposit." The reason why Mr. Morton infers a subsidence of the whole area to the extent of nearly fifty feet, is that when the old land-surface beneath the Custom House, now above forty feet below high-water mark, was covered with vegetation, it must have been sufficiently above the sea-level to have afforded the necessary drainage for the growth of trees. "The most important of these changes,—the origin of the river Mersey by the irruption of the sea, in consequence of the subsidence of the land,—was probably before the occupation of Britain by the Romans; the subsidence of the old forest-beds of Leasowe, Dove Point, and Formby, was no doubt of much more recent date, certainly within the historical period."

Catalogue of Geological Collections, etc. By J. R. Gregory. 1863.

We have received one of Mr. Gregory's Catalogues of Collections of Geology and Mineralogy, Specimens, etc., on sale at his establishment in Golden Square. It contains, among other items, a long list of casts of rare and unique fossils from various museums and other collections, as also a useful list of geological books, periodicals, maps, and diagrams, models of crystals, and other objects. This Catalogue has, moreover, the advantage of being illustrated with eight tolerably good photographs of specimens, cabinets, and other desiderata, which will be found very useful by those who are about to commence the studies of geology and mineralogy, as well as to those who wish to add to their collections. Mr. Gregory's collections can with confidence be recommended, especially his elementary and educational series, for which he obtained a prize medal at last year's International Exhibition.

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